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Ontario Geological Survey
Open File Report 6077

Geology of Burrows, Kemp and Mond Townships, Shining Tree Area

2002

102-06398/

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ONTARIO GEOLOGICAL SURVEY

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Geology of Burrows, Kemp and Mond Townships, Shining Tree Area

by

G. Machado

2002

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GEOLOGICAL MAP

Preliminary Map P.3445: Precambrian Geology of Burrows, Kemp and Mond Townships ..... back pocket

Abstract

During the summer of 2001, bedrock mapping was completed, at 1:20 000, in Burrows, Kemp and Mond townships in the Shining Tree Area which is part of the Abitibi greenstone belt.

The area is underlain by a series of Keewatin metavolcanic rocks, varying in composition from ultramafic to felsic, and unconformably overlain by metasedimentary rocks of the Timiskaming assemblage. These Archean rocks are, in turn, unconformably overlain by the Huronian Supergroup.

Rocks in the map area have, in general, been metamorphosed to lower greenschist facies, except near Jumping Moose Lake and near the granitic batholith, where the metavolcanic rocks and mafic intrusive rocks appear to have undergone lower amphibolite facies metamorphism. Most of the Keewatin metavolcanic rocks have experienced low to moderate degrees of carbonatization, chloritization, silicification and sericitization. No prominent zones of pervasive alteration or intense alteration have been noted.

The area is transected by north-northwest- and east-striking sinistral faults, some of regional extent. The northwest-striking Marne Lake Fault may be an extension of the Mattagami River Fault.

The area has potential to host volcanogenic massive sulphide deposits (VMS) in silicified felsic metavolcanic rocks, gold related to deformation zones and the Timiskaming assemblage, magmatic platinum group element mineralization (PGE) within the Nipissing gabbro and ultramafic-hosted magmatic copper-nickel deposits with Keewatin mafic/ultramafic intrusive rocks and komatiitic units.

Geology of Burrows, Kemp and Mond Townships, Shining Tree Area

G. Machado

Ontario Geological Survey
Open File Report 6077
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Introduction

LOCATION AND ACCESS

This project is part of a multiyear study to re-evaluate the geology and mineral potential of the Shining Tree area, southern part of the Abitibi greenstone belt. The mapped area is bounded by 47°45'30" to 47°51' north latitude and 81°04'30" to 81°27'30" west longitude, covering 266 km^2 and comprising the townships of Burrows, Kemp and Mond (Figure 1). The area has potential for gold, base metal and platinum group element (PGE) mineralization.

The map-area is 70 km southeast of Timmins and can be reached from the south via Highway 560 and the Grassy Road or from Timmins via the Papakomeka-Grassy Road. The Grassy Road connects with the Mattagami Lake Road allowing access to Kemp and Burrows townships. These roads are not maintained. Numerous overgrown roads can be used with all terrain vehicles (ATV). Marne and Grassy lakes, in Burrows and Kemp townships provide boat access. Access into Mond Township is via boat using Ferris and Mond lakes and the Grassy River. In the eastern part of Mond Township, the road servicing the power line provides north-south access. The southern part of Mond Township is accessible by helicopter.

MINERAL EXPLORATION HISTORY

Producing mines were never established in the map area but mineral exploration has been going on sporadically for the last 50 years. Since the discovery, in 1949, of rich gold-bearing float in the Jumping Moose Lake area (Tittley 1998), many claims have been staked and much exploration work has been completed (Assessment Files, Resident Geologist's Office, Kirkland Lake).

Exploration has been aimed towards gold, base metals and platinum group elements (PGE). See the Assessment Files in the Resident Geologist's Office, Kirkland Lake.

PREVIOUS GEOLOGICAL WORK

The townships of Burrows, Kemp and Mond have not been mapped in detail, but appear on existing compilation maps (Pyke 1982). The townships to the south of the map area have been mapped by Carter (1983, 1986 and 1987) and more recently by Johns (1999) and Johns and Amelin (1998). Sothman Township, found north of Kemp Township, has been mapped by Abraham (1951).

PRESENT GEOLOGICAL WORK

Eleven weeks were spent during the summer of 2001 traversing at 400 m intervals, where terrain permitted. Outcrops found on the shorelines of all major lakes were examined. The locations of the outcrops were taken with a Magellan GPS and were plotted on air photos and later on 1:20 000 cronoflex and digital field maps. The field maps were derived from maps of the Ontario Basic Mapping Program, Surveys, Mapping and Remote Sensing Branch, Ontario Ministry of Natural Resources, with

modifications by staff of the Ontario Ministry of Northern Development and Mines. All observations were transferred into a Fieldlog database.

PHYSIOGRAPHY

The area is generally flat lying to moderately undulating except for some, 200 m high hills in Mond Township representing resistant Huronian Supergroup sedimentary rocks. Extensive sand deposits and swamps result in poor rock exposure in Burrows Township.

Major lakes in the area seem to be associated with fault zones. The drainage in Burrows Township is west towards Mattagami Lake. In Kemp Township, the drainage is east towards Grassy Lake and Grassy River, while in Mond Township the drainage is north towards Grassy River.

ACKNOWLEDGMENTS

I would like to thank H. Longuépée for his help as a senior assistant and the junior assistants, L. Greenlaw, M. Hay and L. Radjnovich for their work during the field season. I would like to thank G. Johns for all his input during this mapping project. I would also like to thank J. Rudd for the preparation of numerous geophysical maps and his help in the interpretation of these maps. J. Ayer, N. Trowell and B. Berger are thanked for the many insights they gave me during numerous discussions. Finally, thanks to all the support staff at the Ontario Geological Survey.

Unless otherwise noted, all data for geochemical analyses presented in this report were provided by the Geoscience Laboratories, Ontario Geoservices Centre in Sudbury.

Regional Geological Setting

Jackson and Fyon (1991) first applied the assemblage concept to the Abitibi Subprovince in Ontario and identified 71 supracrustal assemblages. They interpreted these assemblages as Archean analogues to a variety of modern geodynamic settings representing largely allochthonous terranes juxtaposed into their current positions by plate tectonic processes along active continental margins. However, recent mapping and geochronological determinations have led to reinstatement of the more traditional autochthonous stratigraphic model for the southern Abitibi greenstone belt, revealing that when unfolded, a largely coherent stratigraphic succession with similar ages and rock types exists in the Abitibi greenstone belt (Ayer and Trowell 2001). The autochthonous model is supported by widespread evidence of inherited zircons representing the ages of underlying stratigraphy within the overlying volcanic units, thus indicating that upper stratigraphic volcanic units erupted through older units.

Tectonostratigraphic revision utilizing new geochronologic data and the results of regional scale compilation has resulted in the subdivision of 9 distinct stratigraphic Abitibi assemblages (Ayer and Trowell 2001). These are identified on the basis of geochronological, lithological and temporal criteria in Table 1. Based on the regional scale interpretation and more detailed mapping of the assemblages boundaries, it is felt that Burrows, Kemp and Mond townships are underlain by the four assemblages shown in Figure 1, but additional geochronology will be required to test these revisions.

General Geology

The map area is underlain by Neo-archean Keewatin-age rocks, composed of a sequence varying from ultramafic to felsic metavolcanic rocks. These rocks are intruded by a series of metamorphosed mafic to ultramafic sills. In southern Kemp and Mond townships, the metavolcanic rocks are unconformably overlain by a sequence of clastic metasedimentary rocks and reworked metavolcanic rocks of the Timiskaming assemblage. A granitic batholith, located in the northwest part of Burrows Township, intrudes the Keewatin metavolcanic rocks (*see* Figure 2).

A large part of Kemp and Mond townships are covered with Proterozoic sedimentary rocks of the Huronian Supergroup, laying unconformably over the Keewatin-age metavolcanic rocks and Timiskaming assemblage. A Nipissing gabbro, located in the northern part of the area, is intruded into both the Keewatin-age rocks and the Huronian Supergroup. Proterozoic Matachewan diabase dikes are found throughout the map area and are intrusive into all other lithologies.

Rocks in the map area have, in general, been metamorphosed to lower greenschist facies, except near Jumping Moose Lake and near the granitic batholith, where the metavolcanic rocks and mafic intrusive rocks appear to have undergone lower amphibolite facies metamorphism. Most of the Keewatin metavolcanic rocks have experienced low to moderate degrees of carbonatization, chloritization, silicification and sericitization. No prominent zones of pervasive alteration or intense alteration have been noted.

Lithologic units found within the map area are listed in Table 2.

ARCHEAN

Keewatin-Age Metavolcanic Rocks

ULTRAMAFIC METAVOLCANIC ROCKS

Two thin units of ultramafic metavolcanic rocks are found east of Jumping Moose Lake and west of Marne Lake (*see* Figure 2). In the Jumping Moose Lake area the ultramafic rocks were observed in only one outcrop. They are black to dark grey in colour with no visible primary textures. All primary minerals have been altered to serpentine, carbonate and talc. Pseudomorphs of radiating prismatic crystals were observed in thin section and may represent spinifex texture. The location of the outcrop corresponds with a prominent magnetic anomaly on airborne geophysical maps (Ontario Geological Survey 1996) that can be traced for 7 km along Jumping Moose Lake. The unit has been intersected by diamond drilling (Mullen 1983), who describes it as, "A thin talc-carbonate horizon thought to represent an altered komatiitic flow is intercalated with mafic volcanics". As only one outcrop of this unit was mapped, its distribution is solely based on geophysical surveys. Lithogeochemical analyses (*see* Table 3) of this rock unit confirms that it is ultramafic in composition.

The ultramafic metavolcanic rocks west of Marne Lake were not observed during this project, but were described by Mullen (1983) and (Halladay 1992). Two komatiitic flows, 5 metres thick, containing spinifex and cumulate zones were reported (Personal Communication, Falconbridge Exploration, Timmins, Ontario). They have a dark grey weathered surface and are light to dark grey on fresh surfaces. These rocks are altered to talc and chlorite, and host minor pyrite. Near Marne Lake, the unit is apple

green and altered to fuchsite with preserved spinifex textures. The extent of these flow units can be interpreted from aeromagnetic maps (Ontario Geological Survey 1996) over a distance of 10 km.

Table 2: Table of lithologic units for Burrows, Kemp and Mond townships.

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Sand, gravel, till, swamp, and lake deposits

UNCONFORMITY

PRECAMBRIAN

PROTEROZOIC

PALEOPROTEROZOIC

Mafic Intrusive Rocks

Matachewan Swarm

Diabase and feldspar phenocryst diabase

INTRUSIVE CONTACT

Nipissing Gabbro

Gabbro, diabase, quartz gabbro and layered gabbro

INTRUSIVE CONTACT

HURONIAN SUPERGROUP

Gowganda Formation

Conglomerate, quartz-arenite, siltstone and wacke

UNCONFORMITY

ARCHEAN

NEOARCHEAN

Intermediate to Felsic Intrusive Rocks

Granite, monzonite, syenite and quartz-feldspar porphyry

INTRUSIVE CONTACT

Intermediate to Felsic Intrusive Rocks

Feldspar porphyry and feldspar-hornblende porphyry

INTRUSIVE CONTACT

Metavolcanic and Metasedimentary Rocks of the Timiskaming assemblage

Intermediate to Felsic Reworked Metavolcanic Rocks

Wacke, tuff, lapilli tuff, tuff breccia, pyroclastic breccia

Clastic Metasedimentary Rocks

Arenite, wacke, conglomerate, siltstone

Chemical Metasedimentary Rocks

Chert

UNCONFORMITY

NEO TO MESOARCHEAN

INTRUSIVE CONTACT

Metamorphosed Mafic to Ultramafic Intrusive Rocks

Gabbro, diorite, dunite, peridotite, hornblendite, pyroxenite and amphibolite

INTRUSIVE CONTACT

Metavolcanic and Metasedimentary Rocks of Keewatin age

Chemical Metasedimentary Rocks
Magnetite ironstone and graphitic sediments

Intermediate to Felsic Metavolcanic Rocks
Massive, porphyritic and pillowed flows; autoclastic breccia, schist, tuff, lapilli-tuff, lapillistone, tuff breccia and pyroclastic breccia
Mafic to Intermediate Metavolcanic Rocks
Massive, pillowed, amygdaloidal, variolitic, porphyritic flows; autoclastic and pillowed breccia; hyaloclastite, mafic schist
Ultramafic Metavolcanic Rocks
Massive flow, spinifex, serpentinized and talcaceous altered flow

MAFIC TO INTERMEDIATE METAVOLCANIC ROCKS

These rocks outcrop in three areas (*see* Figure 2), an extensive area encompassing most of Burrows and the middle part of Kemp townships; an area separated by the Marne Lake Fault; and a smaller area near Ferris Lake in Mond Township.

In Kemp and Burrows townships the rocks commonly occur as massive, pillowed and variolitic flows, pillow breccia and mafic schist. The pillowed and massive flows are black or dark green on fresh surfaces and weather to a dark brown, rusty brown or dark green. The rocks are typically aphanitic and are cut by quartz filled fractures. Pillow widths vary from 30 cm to 3 m and are rounded to elongated (Photo 1). Pillow rims are chloritized and may contain minor amounts of pyrite. Few quartz- or carbonate-filled millimetre-sized amygdules were noted. Pods of quartz and chlorite, representing large gas cavities, are found in the middle of some pillows. Variolitic and brecciated, pillowed flows are interbedded locally with massive and pillowed flows, but are not extensive (Photo 2). Variolitic flows on the Sinclair Lake shoreline contain varioles that are up to a centimetre in size, rounded, white and embedded in a green crystalline matrix. In the Jumping Moose and Marne lakes area, the mafic metavolcanic rocks are schistose due to their close proximity to fault zones. They are highly foliated, dark green to black and do not contain preserved primary volcanic textures.

As seen in thin section, the mafic metavolcanic rocks in Burrows Township are very homogeneous and dark brown. They are composed of fine euhedral plagioclase microlites and pyroxene crystals with minor chlorite alteration. Mafic metavolcanic rocks from the Jumping Moose Lake area contain fine-grained carbonate, chlorite and sericite and show a definite foliation. In thin sections, the mafic to intermediate metavolcanic rocks, found east of the Marne Lake Fault, are a little different from the ones west of the Marne Lake Fault. They both contain plagioclase microlites with minor pyroxene and olivine crystals in a devitrified glass matrix (Photo 3). Varioles are mostly bow-tie in shape. They are partly chloritized and carbonatized.

In the Ferris Lake area, the mafic to intermediate metavolcanic rocks occur as massive, pillowed, brecciated pillows and autoclastic breccia flows. The pillowed and massive flows comprise 80% of the sequence. They are dark green or black and weather brown to rusty brown. The difference between this sequence and the one in Burrows and Kemp townships is the size of the pillows which are up to five metres long, and contain 10% to 20% quartz and/or carbonate filled amygdules. These rocks also exhibit a higher degree of secondary quartz and chlorite and carbonate alteration. Pyrite is more abundant, but are still a minor constituent of the flows. Brecciated pillows and autoclastic breccia are found locally interbedded with massive and pillowed flows. As seen in thin sections, rocks from the Ferris Lake area are dark brown and composed of 90% plagioclase microlites with secondary amphibole, subhedral pyroxene crystals, devitrified glass (Photo 4) and a few bow-tie shaped varioles.

The Keewatin mafic metavolcanic rocks were deposited in a deep, subaqueous environment as evidenced by the copious pillows and lack of abundant amygdules. The paucity of interflow sediments between the mafic flows indicates rapid accumulation of lava.

Lithogeochemistry was completed on samples of mafic to intermediate metavolcanic affinity (Table 4a and b) and different rock classification plots were made (Figure 3). Figure 3A shows that all rocks, except those east of the Marne Lake Fault, have a tholeiitic affinity. The rare earth element (REE) plot and the binary plot (Figure 3B and 3D) shows that the samples east of the Marne Lake Fault have a different geochemical signature from the other mafic to intermediate metavolcanic rocks. Figure 3C indicates that the samples west of the Marne Lake Fault vary in composition from komatiitic basalt to tholeiitic basalt, while the samples east of the Marne Lake Fault vary in composition from calc-alkalic basalt to calc-alkalic andesite. The samples from Ferris Lake vary in composition from high magnesium tholeiitic basalt to tholeiitic andesite. The sample that has a komatiitic basalt signature was collected near the komatiite in Burrows Township and could be related to that unit. The rocks east of the Marne Lake Fault have a different geochemical affinity than the other rocks, implying that they could be related to the same event that produced the felsic to intermediate metavolcanic sequence in Kemp Township.

FELSIC TO INTERMEDIATE METAVOLCANIC ROCKS

Three packages of felsic to intermediate metavolcanic rocks were found in the map area (*see* Figure 2). These rocks outcrop in the western part of Burrows Township, in southern Kemp Township and in northern Mond and Kemp townships.

The sequence in the western part of Burrows Township is highly deformed where it is intruded by the granitic batholith and sheared by faults near Jumping Moose Lake. Most of the rocks are light grey quartz-feldspar porphyry schists that weather light pink or white. No primary volcanic textures are preserved, therefore, it is difficult to distinguish the metavolcanic rocks from some of the intrusive felsic rocks. Seen in thin section these rocks have 1-2 mm rounded quartz and sericitized feldspar phenocrysts in a fine-grained (0.1 mm) foliated matrix composed of quartz, feldspar, muscovite and minor biotite. In outcrop, where the rocks are less deformed, it is possible to identify volcaniclastic rocks ranging from tuff to lapillistone. Fragments are rounded or sub rounded and amygdaloidal. A good exposure of this unit is in Jumping Moose Creek where the creek crosses the snowmobile trail to Mattagami Lake (Photo 5). The lack of any pyroclastic flow features and the fact that the matrix and fragments are composed of the same material indicates that the rock may have been redeposited by a debris flow mechanism. Due to the lack of top indicators it is difficult to determine the relationship between this unit and the adjacent mafic metavolcanic flows.

A wide band of felsic to intermediate metavolcanic rocks is found in southern Kemp Township. Near Marne Lake they are pyroclastic and volcaniclastic in origin. To the east, towards Grassy Lake, the character of the rocks changes to quartz and/or feldspar porphyritic flows which change laterally into massive and autoclastic breccia flows that comprise the bulk of the sequence.

Pyroclastic rocks are best observed on Marne Lake. They are light grey on fresh surface and have a white weathered surface. Thin tuffaceous layers are interbedded with metre thick beds of lapilli tuff. All clasts are massive and contain minor amygdules. Exposures of these rocks are confined to Marne Lake.

The quartz and/or feldspar porphyritic flows can be traced intermittently to the east of Marne Lake for about 2500 metres. They have a fine-grained massive matrix, a light grey or light green fresh surface and a white weathered surface. The subhedral phenocrysts make up 5 to 10% of the rock and are between

1 and 10 mm in size. The composition seen in thin sections is 90%, euhedral to subhedral, plagioclase (An_{30}) crystals. All rocks are chloritized and sericitized.

The massive and autoclastic breccia flows form 90% of the sequence and are best observed on a 2 km long ridge, 200 m west of Grassy Road (*see* Figure 2). They are intimately related and are often seen together in the same outcrop. The massive flow is light grey, greenish grey or light green on fresh surfaces and are white weathered surfaces. The rocks locally contain some quartz amygdules, feldspar phenocrysts and disseminated pyrite. The autoclastic breccia flow is light grey or greenish grey and weathers white (Photo 6). The breccia fragments are angular and vary in size (1 cm to 50 cm) and shape and have the same composition as the matrix. The breccia was formed as the flow was erupted due to the high viscosity of the lava or due to the high hydrostatic pressure caused by the water column. Locally, the flow contains quartz- or carbonate-filled amygdules. These rocks are hard and brittle and locally contain chlorite and carbonate alteration. Seen in thin sections, both flows are similar in appearance and are composed of sericitized feldspar microlites, partly chloritized matrix (Photo 7) and contain up to 10% quartz and/or carbonate-filled amygdules (2 mm) (Photo 8). In some thin sections it is possible to see faint flow banding.

The felsic to intermediate metavolcanic sequence in northern Mond and Kemp townships may be part of the Halliday felsic dome (Mullen 1983) centered in Halliday and Sotham townships to the north. Massive, pillow, autoclastic breccia and porphyritic flows are found in this sequence. The flows are massive and pillowed (Photo 9) along the Grassy River and Ferris Lake and are dark green on fresh surfaces but have a brownish appearance on weathered surfaces. This part of the sequence is intermediate in composition and may be the southern edge of the Halliday felsic dome. The rest of the sequence, toward the north edge of the townships, consists of massive flows, autoclastic breccia and/or porphyritic flows. These flows are green or light green and have light grey or white weathered surfaces. They contain up to 50% locally quartz- and/or carbonate-filled amygdules. Subhedral, feldspar-phyric flows are also found and hyaloclastites can be observed in a few locations. In thin section, it is possible to see sericitized feldspar microlites with 10% subhedral to euhedral, sericitized, feldspar phenocrysts 1to 4 mm in size. Amygdules are filled with a mixture of quartz and carbonate.

Based on their association with the surrounding mafic metavolcanic rocks, the felsic to intermediate metavolcanic rocks are presumed to have been deposited subaqueously and are interpreted to range in depositional mode from massive flows with autoclastic breccia to ash flows and resedimented debris flows. Size and sorting of the clastic rocks cover the range from pyroclastic breccia to lapilli tuff to tuff. The sequence, found in southern Kemp Township, seems more proximal to vent facies in the Marne Lake area and more distal towards the east, however, vent facies rocks have not been positively identified.

Lithogeochemistry conducted on the felsic to intermediate metavolcanic rocks are presented in Table 5a and 5b and in Figure 4. Samples taken in western Burrows Township vary in composition from calc-alkalic dacite to tholeiitic dacite (Figure 4A and 4C). Samples taken in southern Kemp Township vary from high iron tholeiites to calc-alkalic rhyolite (*see* Figure 4A and 4C), but most are calc-alkalic and vary from felsic to mafic south to north. Samples taken in northern Kemp and Mond townships vary from calc-alkalic andesite to calc-alkalic dacite (*see* Figure 4A and 4C). Andesites are found near Grassy River and Ferris Lake, at the edge of the Halliday Dome. REE patterns of these three sequences are very similar (*see* Figure 4B), all are enriched in light rare earth elements (LREE) compared to heavy rare earth elements (HREE) and slopes of the REE patterns are the same.

CHEMICAL METASEDIMENTARY ROCKS

Iron formation was intersected in diamond drill core near Jumping Moose Lake (Mullen 1983, Pyke 1982) (*see* Figure 2). It is associated with mafic and ultramafic metavolcanic rocks and likely represents interflow metasediments. Mullen (1983) described the rocks as "Massive and amygdaloidal, pillowed, tholeiitic basalts with intercalated, contorted, garnetiferous, magnetite-chert-pyrite iron formations." These rocks have not been encountered in outcrop but may be responsible for a total field magnetic anomaly on aeromagnetic maps (Ontario Geological Survey 1996).

Metamorphosed Mafic to Ultramafic Intrusive Rocks

Mafic to ultramafic intrusive rocks are common in Burrows and Kemp townships (*see* Figure 2). They appear as sill-like bodies, between 1 and 2 km long, intruding the Keewatin metavolcanic rocks. They are green, dark green or black on fresh surface and weather black or a mottled black and white. They vary in composition from dunite, peridotite, pyroxenite, gabbro or diorite.

Gabbros are the most common and make up 90% of the intrusions. Usually they are fresh and primary igneous textures, such as sub-ophitic textures, are well preserved. Seen in thin section the pyroxenes are partly altered to amphiboles and the plagioclase is sericitized. In the more dioritic rocks the quartz shows undulatory extinction. These rocks are medium to coarse-grained and are usually equigranular. Minor pyrite and leucoxene crystals are disseminated throughout the intrusions.

In the Jumping Moose Lake area, where the intrusions are metamorphosed to amphibolite facies, their mineralogical content is 90% amphibole and 10% sericitized plagioclase. These rocks are fine-grained and foliated.

Timiskaming Assemblage

The Timiskaming assemblage is located in southern Mond and southeastern Kemp townships (*see* Figure 2). To the south of the map area the Timiskaming assemblage unconformably overlies the Keewatin metavolcanic rocks (Johns 1999). This relationship was not observed in the map area. The assemblage was divided into three units in the map area 1) clastic to volcaniclastic metasedimentary rocks; 2) reworked metavolcanic rocks; and 3) chemical metasedimentary rocks. Clastic metasedimentary rocks range from siltstone, wacke, sandstone, and polymictic conglomerate, whereas the reworked metavolcanic rocks range from primary pyroclastic to volcaniclastic-epiclastic rocks. A few lenses of oxide facies chemical metasedimentary rocks are also found.

According to geochemistry (Table 6 and Figure 5) the Timiskaming assemblage is calc-alkalic felsic to intermediate in composition and is enriched in LREE compared to HREE. The constant slope of REE is characteristic of rocks from the Timiskaming assemblage (J. Ayer, Geoscientist, Ontario Geological Survey, personnal communication, 2001). This sequence of the Timikaming assemblage was deposited rapidly, possibly by debris flow and turbidite mechanisms in a fluvial or deltaic environment.

CHEMICAL METASEDIMENTARY ROCKS

Chert was only seen in a few outcrops in Mond Township, south of Seganku Creek where it is interbedded with sandstone. Chert is massive, thinly bedded and dark grey to black. While the unit is not

continuous, it could possibly be found in other outcrops in the area. Chert and jasper fragments are found in the clastic metasedimentary rocks and the reworked metavolcanic rocks of the Timiskaming assemblage. These fragments are rounded and vary greatly in quantity and size.

CLASTIC METASEDIMENTARY ROCKS

Metasedimentary rocks comprise 85% of the Timiskaming assemblage (*see* Figure 2). They are found in the southern part of Mond Township and in southeast Kemp Township. The sequence is continuous except where it is displaced by the Marne Lake and Seganku Lake faults. The conglomerate, forming 20% of the metasedimentary rocks, is polymictic, usually matrix supported and the clasts have a wide range of compositions such as chert, jasper (Photo 10), mafic metavolcanic rocks, felsic metavolcanic rocks, metasedimentary fragments and volcaniclastic rocks (Photo 11). The fragments range in size from 1 cm to 10 cm and are rounded (volcaniclastic) to sub-angular (chert and jasper). The matrix is composed of quartz, feldspar and amphibole. Euhedral crystals of amphibole and feldspar are visible in the outcrop. Fresh surfaces are grey, dark grey or black, while weathered surfaces are white or light grey.

Wacke (60% of the unit) and immature sandstone (20% of the unit) have the same composition and colour as the conglomerate. Wacke and sandstone are often found together in the same outcrop and are commonly interbedded (Photo 12) with metre size beds. Cross-bedding (Photo 13) and rip-up clasts can be found in the sandstone but these features are subtle and a fresh surface is necessary to view them.

Seen in thin sections, these three units are composed of well preserved euhedral amphibole crystals (1 mm), zoned euhedral plagioclase crystals and some pyroxene. Usually, all the feldspars are sericitized and the rocks are chloritized. In some samples taken near Seganku Lake, it is possible to see pumice fragments in an ash matrix.

Siltstone, composed of quartz and feldspar, is the only mature unit in the assemblage and does not commonly occur in the map area. Thin beds of siltstone are usually found interbedded with sandstone or wacke units. Siltstone has both a black to dark grey weathered and fresh surface. Bedding and cross bedding are common.

INTERMEDIATE TO FELSIC REWORKED METAVOLCANIC ROCKS

This sequence forms 15% of the Timiskaming assemblage in the mapped area (*see* Figure 2). It is found east of Grassy Lake and in southeastern Mond Township. It is in contact with the clastic metasedimentary rocks of the Timiskaming assemblage. The contact is gradational and thin units of reworked metavolcanic rocks can be found within the clastic metasedimentary sequence and vice versa. The differences between them are subtle and require close examination. To be classified as reworked metavolcanic rocks, primary volcanic structures and textures must be in evidence.

The sequence of intermediate to felsic reworked metavolcanic rocks east of Grassy Lake comprises wacke, tuff, lapilli tuff and tuff breccia. The majority of the sequence (85%) is volcaniclastic to epiclastic wacke. The wacke is grey on fresh surfaces but weathers light grey to brown. It is composed of intermediate angular to sub-rounded fragments, of varying size, in a fine-grained felsic matrix. The fragments are composed of euhedral to subhedral crystals of amphibole (Photo 14) and plagioclase, lithic ash and other lithic clasts. The matrix of the wacke is immature and consists of quartz and feldspar. This unit is a mixture of fragments that may have been disturbed when unconsolidated.

Centimetre to metre thick bedded pyroclastic rocks are found within the wacke. They are similar in appearance and composition to the wacke but only differ in size, sorting and degree of rounding of the fragments. Tuff, lapilli tuff and tuff breccia have been noted. A 20 centimetre thick bed of lapilli tuff comprising accretionary lapilli was found, indicating eruption under moist, subaerial conditions.

The second sequence, located in southeastern Mond Township, is composed of wacke, tuff and pyroclastic breccia. Wacke is grey on fresh surfaces and weathers white to light grey. The wacke is composed of rounded to angular fragments of feldspar, quartz, amphibole, chert, jasper and also some volcanic fragments (Photo 15). The majority of the sequence is composed of tuff comprising rounded to sub-rounded quartz, amphibole and feldspar crystals. Tuff is grey-green and weathers white. No primary structures were visible. Pyroclastic breccia is similar to the tuff, except that the fragments are block and lapilli size. It has the same composition as the tuff.

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

These are found as prominent ridges in Mond Township and are intrusive into the rocks of the Timiskaming assemblage (see Map P.3445, back pocket). Two types of intrusions have been recognized in the area: feldspar porphyry and feldspar-hornblende porphyry. They both are grey-green on fresh surfaces and weather brown. They are fine- to medium-grained with 1 to 3 cm phenocrysts. The groudmass is composed of feldspar, amphibole and minor quartz. These intrusions are sill-like and follow the bedding of the surrounding clastic metasedimentary rocks.

Intermediate to Felsic Intrusive Rocks

The Kenogamissi Batholith (*see* Figure 2) underlies northwestern Burrows Township. Textures vary from hypidiomorphic equigranular to foliated near the contact with the metavolcanic rocks and faults. Grain size of the quartz, potassium-feldspar and plagioclase increases from fine to coarse away from contacts and toward the interior of the batholith. Compositionally, the batholith is granitic, quartz-syenitic or quartz-monzonitic and contains biotite as the main mafic mineral. In places, amphibole, muscovite and pyroxene appear as minor constituents. Seen in thin section, it is possible to see perthitic textures in the fresher samples. Lithogeochemistry was conducted on three samples from the batholith (*see* Table 3) and plotted on two diagrams (Figure 6). The intrusion is weakly peraluminous and was formed in volcanic-arc environment. REE patterns are very similar and suggest a continuous crystallization of the feldspars. It is possible that this batholith comprises several plutons or magmatic pulses; explaining the compositional variation and the large aerial extent of the batholith. This is similar to the observations made by Becker and Benn (2000) in their study of the Kenogamissi Batholith to the west of the map area.

PROTEROZOIC

Huronian Supergroup

GOWGANDA FORMATION

This sequence covers an extensive part of the map area (*see* Figure 2). It lies unconformably over the Archean rocks and is composed of mature, well sorted conglomerate, quartz arenite, wacke and siltstone.

Conglomerate is polymictic, matrix supported, pink or grey and weathers to a reddish hue. No primary sedimentary structures can be seen. Clasts are sub-rounded to rounded, vary in size from 5 cm to 70 cm and are composed of; felsic metavolcanic rocks, mafic metavolcanic rocks, granite, diorite and gabbro. The matrix is sand size and is primarily composed of quartz. Conglomerate beds are thicker than 1 metre.

Quartz arenite is red, grey or green, homogeneous, mature and well-sorted. All mineral grains are rounded. The arenite may contain granite dropstones of 1 to 30 cm in diameter. Quartz-arenite beds are between 20 and 40 cm thick (Photo 16) and are sometimes interbedded with siltstone. The siltstone has a dark grey fresh surface, weathers white and has a vitreous luster on the fresh surface. It is thinly bedded with 5 mm to 2 cm thick beds in metre thick sequences (Photo 17). The siltstone is bedded and cross-bedded.

Primary sedimentary structures were not observed in these rocks except for bedding that is generally flat-lying with a dip between 0° and 25° with minor cross bedding.

The Sansawaju Mountain (Mond Township) is an excellent example of Huronian sedimentary rocks. Along the mountain face it is possible to see alternating beds of siltstone, arenite and conglomerate with conglomerate occurring at the top.

NIPISSING GABBRO

One gabbro intrusion, interpreted to be of Nipissing-age, occurs in the map area and is found in northern Mond Township (*see* Figure 2). The east-striking intrusion can be traced on airborne geophysical magnetic maps (Ontario Geological Survey 1996) into Kemp Township. This unit contains magmatic layering. On a 50 m cross section of an outcrop on the Grassy River it is possible to recognize eight sub-units of variable appearance (Figure 7).

All sub-units have the same dark grey to black colour, except for sub-unit 6, which has a light grey colour.

Sub-unit 1: This is a massive, medium-grained, equigranular, dark grey to black rock that is gabbro-noritic in composition. It is composed of 75% sericitized plagioclase, 15% chloritized pyroxene and 10% leucoxene and ilmenite.

Sub-unit 2: There is a gradational contact between sub-unit 1 and sub-unit 2. Sub-unit 1 and 2 are similar except for the presence of 5% quartz grains and quartz-magnetite veins in sub-unit 2.

Sub-unit 3: There is a sharp contact between sub-unit 3 and sub-unit 2 (Photo 18). The mineralogy and composition is similar to sub-unit 2 but sub-unit 3 is coarse-grained and shows ophitic texture between plagioclase and pyroxene crystals. No quartz-magnetite veins are found in this sub-unit.

Sub-unit 4: The contact between sub-units 3 and 4 was not observed. This sub-unit is in all aspects similar to sub-unit 1.

Sub-unit 5: The contact between sub-units 4 and 5 was not observed. This sub-unit is massive, medium to coarse grained and exhibits radiating crystals of plagioclase. On outcrop, the entire rock appears fresh, but in thin section it is possible to see that it has been carbonatized and sericitized. Primary minerals were probably plagioclase and pyroxene. Large and elongated plagioclase crystals are radiating giving the rock a glomeroporphyritic texture. This sub-unit contains 10% leucoxene and a few quartz grains.

Sub-unit 6: Sub-unit 6 is found within sub-unit 5 (*see* Figure 7)and contacts between them are sharp. The sub-unit is massive, medium- to coarse-grained. It is composed of 20% broken quartz phenocrysts and 5% leucoxene in a sericitized feldspathic matrix.

Sub-unit 7: The contact between sub-units 5 and 7 was not observed. This sub-unit is massive, equigranular and medium-grained. It is highly sericitized and chloritized as seen in thin section. It is possible to see the remnants of euhedral plagioclase and pyroxene crystals. It contains 10% leucoxene crystals and 5% secondary quartz. This sub-unit was gabbronoritic to gabbroic in composition.

Sub-unit 8: The contact between sub-units 7 and 8 is sharp. This sub-unit is light in colour, massive, equigranular and medium-grained. As seen in thin section, the rock is highly altered, composed of sericite and carbonate minerals replacing plagioclase crystals.

Lithogeochemistry was conducted on some samples of Nipissing Gabbro (Table 7), all samples are ultramafic to mafic. Geochemistry does not reflect all the variations seen on outcrop and thin sections.

This outcrop (01-HL-1237) shows the most variable compositions. Other outcrops have centimetre scale layering with the white and green layers representing differentiation between plagioclase and pyroxene. Throughout the intrusion ilmenite and leucoxene crystals are present.

MATACHEWAN SWARM

Matachewan diabase dikes are found throughout the map area (*see* Figure 2) cross cutting all lithologies. They are generally north- to northwest-striking, magnetic, green-black on fresh surface and rusty-brown on weathered surface. They are massive, fine-grained, homogeneous and sometimes contain green epidotized plagioclase phenocrysts (1-2 cm). Matachewan diabase is composed of 40-50% calcic plagioclase, clinopyroxene (40-50%) and amphibole (<10%). All these crystals are euhedral to subhedral. They can also contain minor amounts of pyrite, magnetite and quartz. They were emplaced during periods of extension in the crust during the Paleoproterozoic. The dikes standout as ridges against the surrounding topography in the mapped area.

Structural Geology

The entire map area has been disrupted by northwest-, northeast- and east-striking faults (*see* Figure 2). Most of the faults appear to have a sinistral offset and steeply dipping like the Marne Lake Fault where the lateral displacement is 3 to 4 km to the north. The Marne Lake Fault could be part of the Mattagami River Fault (J. Ayer, Geoscientist, Ontario Geological Survey, personal communication, 2001). Deformation is restricted to these fault zones and their lateral extent is minimal. The faults resulted in shearing and foliation in the surrounding rocks especially in the Jumping Moose area. Faults in Mond Township, especially near Ferris Lake, affect the Huronian sedimentary rocks as well as the metavolcanic rocks.

Folding occurs in the area. A series of synforms and antiforms with fold axes trending northwest is found in the metavolcanic rocks west of Marne Lake. Using opposing top determinations in the Timiskaming assemblage, one synform was recognized, trending north and two more folds may be present in the assemblage east of Grassy Lake. Folding possibly related to the faulting also affects the Huronian sedimentary rocks north of Ferris Lake where two generations of folds, trending northeast with shallow dips were seen on outcrop. These folds are probably localized to that area.

The Keewatin-age metavolcanic rocks in Burrows and Kemp townships have different structural features depending on the location. Mafic and felsic metavolcanic rocks west of Marne Lake, strike northeast and young, as suggested by pillow facings in the mafic metavolcanic rocks, towards the southeast. Tectonic foliation is not present except for the Jumping Moose Lake area, where the foliation strikes northeast and dips steeply 65°-90° towards the southeast.

East of Marne Lake the felsic metavolcanic rocks strike east and have a northeastern tectonic foliation dipping 65°-90° towards the southeast. The mafic metavolcanic rocks, north of this felsic unit, strike northwest and young, as suggested by pillows, towards the southwest. The mafic rocks, south of the felsic unit, strike east with an east-striking tectonic foliation.

In Mond Township, the mafic metavolcanic rocks south of Ferris Lake, strike north and young towards the east. The felsic metavolcanic rocks north of Ferris Lake strike east-northeast and young towards the north.

Stratigraphy within the Timiskaming assemblage has variable strikes depending on position in the sequence. The strike varies from northeast to west with 65°-90° dips. The younging direction changes from north to south across the antiform or synform.

The granitic intrusive rocks in Burrows Township are foliated along the margin of the batholith. The foliations parallel the contact with the metavolcanic rocks and the dip is moderate to steep to the southeast. Lineations are subvertical, near Jumping Moose Lake. This implies a possible forceful diapir-like emplacement.

The Huronian Group sedimentary rocks are relatively flat lying with 0°-25° dips.

Correlation of Geology and Geophysics

Airborne geophysical magnetic surveys have been flown over the three townships (Ontario Geological Survey, 1996). These data can be used, to some degree, to correlate and interpret structure and lithology.

The regional magnetic fabric of the rock units is not easily seen because the magnetic Matachewan diabase dikes mask the magnetic signature of the supracrustal rocks.

The airborne geophysical maps are useful for distinguishing lithologies. In Burrows Township, a large high magnetic anomaly, trending northeast, corresponds to an iron formation interbedded with a komatiitic unit. The northwest corner of Burrows Township corresponds to a magnetic low and this represents the granitic intrusion. The high magnetic anomalies in Burrows Township, roughly trending north, correspond to Matachewan diabase dikes.

The airborne geophysical maps are useful for defining the Nipissing Gabbro in Kemp and Mond townships where it appears as a high magnetic anomaly. There is also a distinct change in magnetic pattern between the Keewatin metavolcanic rocks and the Timiskaming assemblage. The airborne geophysical maps do not reflect the Huronian sediments but are a reflection of the Archean basement. The large magnetic anomaly south of Ferris Lake represents an ultramafic intrusion.

The airborne geophysical maps are useful for interpreting large structural features like faults and folds. In many areas where outcrop coverage is scarce, the faults were interpreted using the geophysical data. Faults occur as breaks in the magnetic patterns and they correlate with structural features observed in the field, this is particularly true for the Grassy Lake and Marne Lake faults. Curvature in magnetic patterns is interpreted to represent fold structures in Burrows Township and allows for the interpretation of folds that were not indicated by outcrops.

Overall there is a good correlation between geology and the airborne geophysical maps.

Economic Geology

The geological context of the region is favourable for gold deposits associated with faults and felsic intrusions. Potential for volcanic-hosted massive sulphide deposits (VMS) exists in the silicified felsic metavolcanic rocks. PGE and nickel may occur in the numerous mafic intrusions. Silver may be found in the areas where Nipissing gabbro intrudes Huronian sedimentary rocks and Keewatin metavolcanic rocks; similar to those deposits found in the Cobalt and Elk Lake areas.

Five samples were collected by the field party to test for PGE, base metal and gold mineralization. Three of the samples were collected from the layered Nipissing gabbro and the other two samples came from the felsic metavolcanic sequence in southern Kemp Township. None of the samples gave values above the detection limit.

DESCRIPTION OF PROPERTIES

(1) H.Z. Tittley - Jumping Mouse Property

In 1998, H.Z. Tittley held 53 claims in the Jumping Moose Lake area. The claim area is underlain by ultramafic to felsic metavolcanic rocks and chemical metasediments next to the granitic batholith. The area is cross-cut by at least two major faults. The work done in the area includes; line cutting, trenching, diamond drilling, magnetic surveys, self-potential surveys, VLF electromagnetic surveys and horizontal loop electromagnetic surveys. Gold values ranging up to 2.67, 0.6, 0.34, 0.20, 0.14 and 0.10 ounces per

ton occur in quartz veins, mineralized syenite, iron formation, mafic tuffs, felsic pyroclastics and quartz zones respectively (Tittley 1998). The claims remain in good standing as of September 2001.

(2) L.B. Halladay (1992)

In 1992, four claims were held by L.B. Halladay west of Marne Lake. The area is underlain by a komatitic flow and mafic to intermediate metavolcanic rocks, cut by mafic Keewatin intrusive rocks and by Matachewan diabase. Work in the area, consisting of geological mapping, ground geophysics, overburden testing and diamond drilling was conducted by Newmont prior to the 1992 work of Halladay. The latest work consisted solely of prospecting along traverses and the subsequent sampling of occurences of quartz veins, sulphides and/or iron carbonate alteration. The claims were allowed to lapse.

(3) Falconbridge Limited (1983)

Falconbridge Limited held some claims west of Marne Lake, just north of the Halladay property, where they conducted some prospecting, following diamond drilling done by Newmont. The area is underlain by ultramafic and mafic metavolcanic rocks, mafic and ultramafic intrusions and Matachewan diabase. A showing of zinc mineralization was found in the metavolcanic rocks. The claims were allowed to lapse.

(4) Hanna Mining Corporation (1986)

Claims were held by the Hanna Mining Corp. in southern Burrows Township, at the boundary with Cabot Township. The area is underlain by mafic to intermediate metavolcanic rocks and mafic to ultramafic intrusions. Line cutting, geophysical work and diamond drilling were done in the area. This resulted in the discovery of a zinc showing. No further work was done due to the lack of outcrop in the area and the claims were allowed to lapse. The ground is now held by Mr. Frederick Blacke.

(5) Orogrande Resources

In 1997, seven claims were held by Orogrande Resources, just west of Grassy Road in southern Kemp Township. The area is underlain by felsic to intermediate Keewatin-age metavolcanic rocks and by Timiskaming assemblage reworked volcanics and sediments. Base metal exploration in the area started in 1965, when the Consolidated Mining and Smelting Company of Canada Limited diamond-drilled two holes. In 1991-92 ASARCO Exploration Company did geological mapping, diamond-drilled a hole and horizontal loop electromagnetic and magnetic surveys were completed. The latest work, done in 1995-96 by Orogrande Resources, involves prospecting and sampling and a HLEM survey. The felsic to intermediate metavolcanic rocks have been silicified and have potential for volcanogenic massive sulphide (VMS) deposits (Hanych 1996). The claims were allowed to lapse.

RECOMMENDATIONS FOR MINERAL EXPLORATION

Although no viable mineral deposits have yet been found in Burrows, Kemp and Mond townships, the mineral potential remains high because of the nature of the underlying rocks and the numerous fault zones in the area.

The area is promising for gold due to the presence of granitic intrusions and major fault zones. Many gold deposits in the Abitibi greenstone belt are spatially associated with syenitic stocks, Timiskaming assemblage rocks and deformation zones (Robert 1997).

The felsic to intermediate metavolcanic rocks in southern Kemp Township have been silicified and have potential for volcanogenic massive sulphide (VMS) deposits (Hanych 1996). The felsic metavolcanic rocks in northern Kemp Township should also be regarded as a possible target for VMS mineralization.

A low-grade nickel ore-body (300 000 tons of 0.9% Ni) has been outlined (Mullen 1983) in a mafic intrusion in Sothman Township with its continuation into Kemp Township. This ore body is currently under investigation by Hucamp Mines Limited. The host rocks may be an ultramafic flow or intrusion. An airborne geophysical magnetic anomaly, that is similar to the anomaly (Ontario Geological Survey 1996) associated with the nickel sulphide mineralization, is located southeast of Ferris Lake but is covered by Huronian sedimentary rocks.

The layered Nipissing gabbro, north of Grassy River, should be investigated in more detail because the differentiation processes responsible for the formation of magmatic igneous layering can also serve to concentrate platinum group elements or other metals. Nipissing gabbro are known to have PGE potential (Jobin-Bevans et al. 1999). The Nipissing gabbro intrudes Huronian sedimentary rocks in close proximity to the Keewatin metavolcanic rocks and this configuration is known to contain silver deposits in the Cobalt region.

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Figure 1: Assemblage map of Burrows, Kemp and Mond townships.

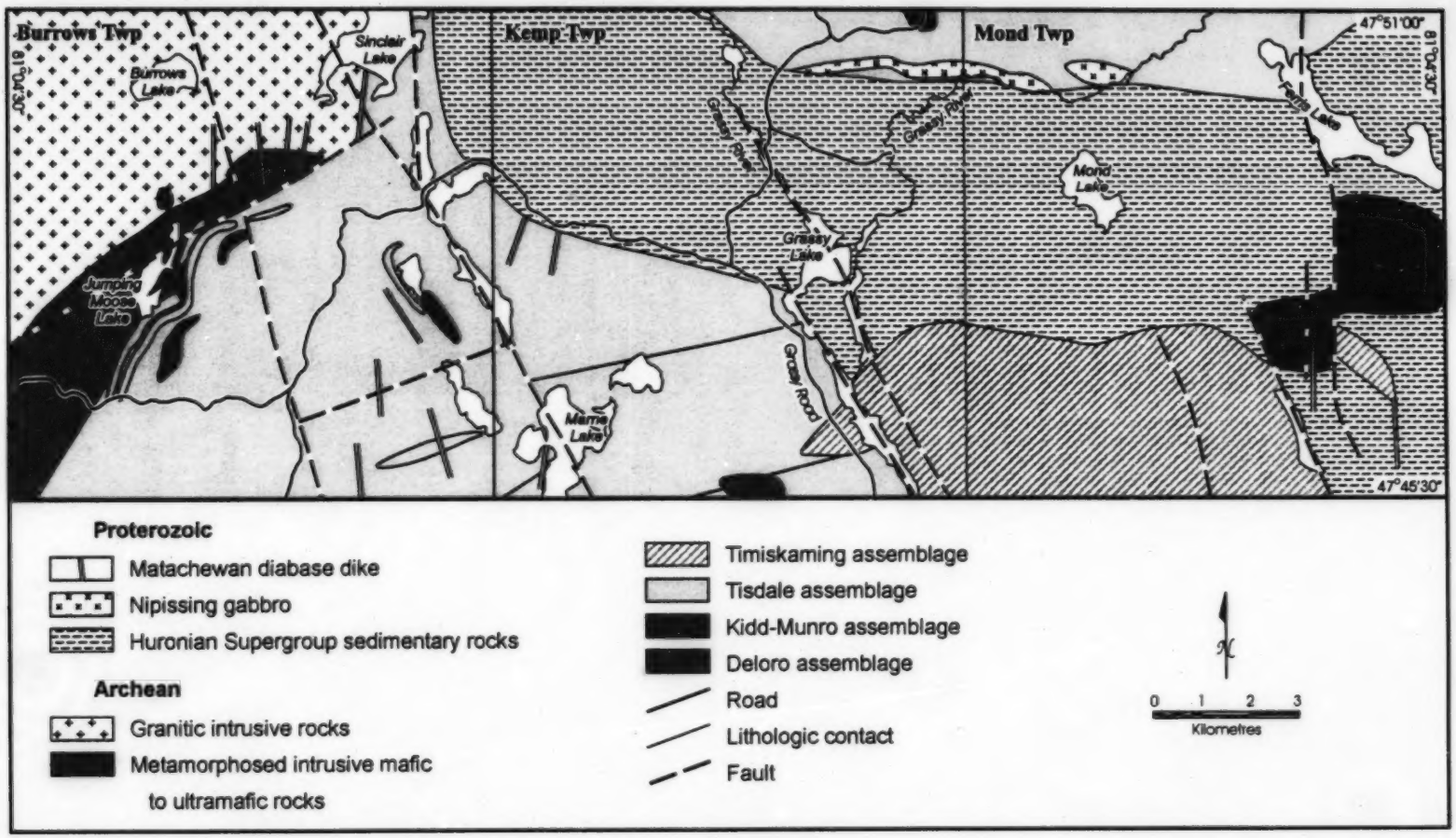

Figure 2: Simplified geology of Burrows, Kemp and Mond townships.

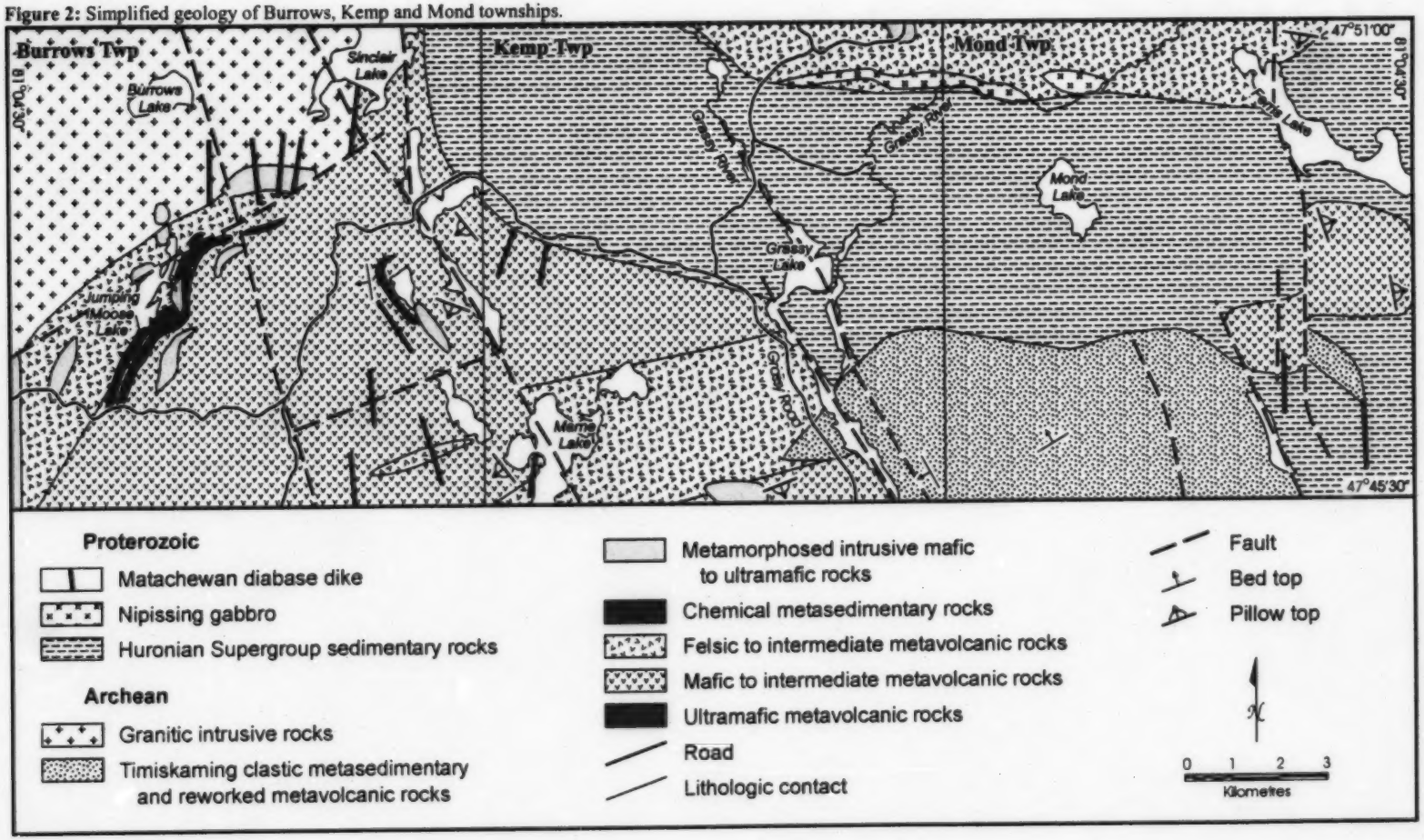

Figure 3: Graphs characterizing mafic to intermediate metavolcanic rocks in the mapped area. A) Irvine and Baragar plot. B) Rare earth element plot. C) Jensen diagram. D) Binary plot of K2O versus SiO2.

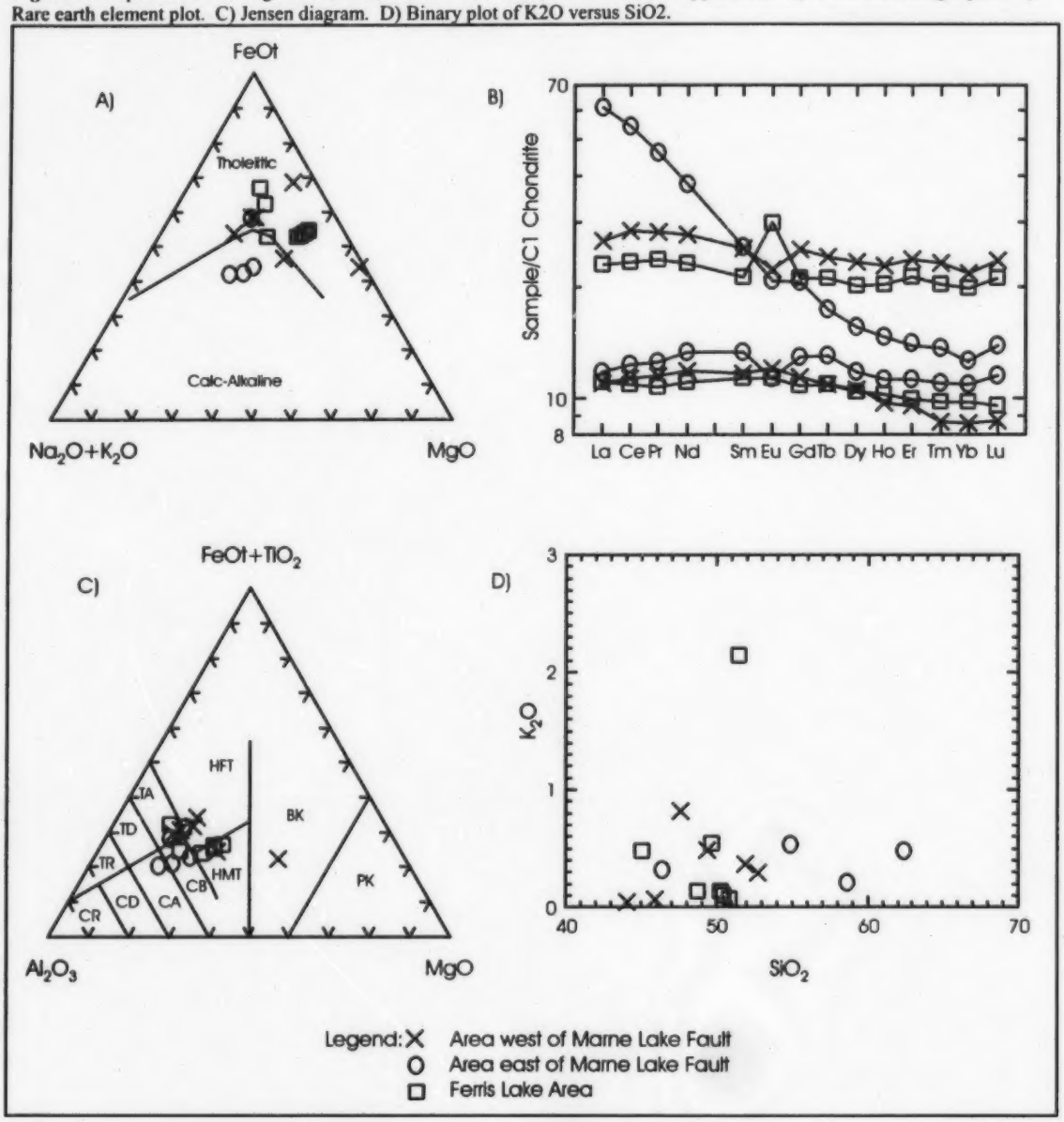

Figure 4: Graphs caracterizing felsic to intermediate metavolcanic rocks in the mapped area. A) Jensen diagram. B) Rare earth element plot. C) Irvine and Baragar plot. D) Binary plot of Na2O+K2O versus SiO2.

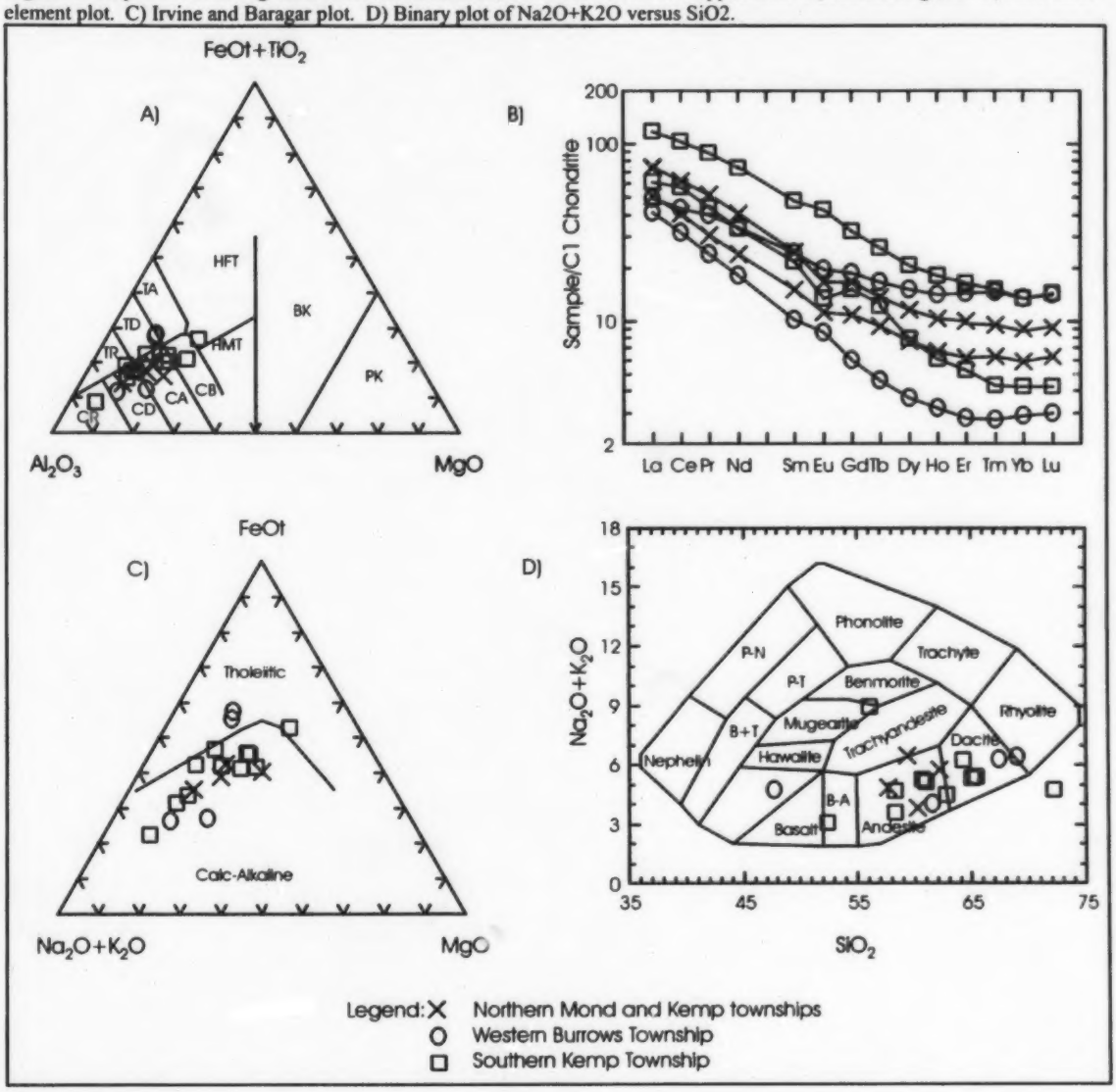

Figure 5: Diagrams for Timiskaming Assemblage. A) Jensen plot. B) Rare earth elements plot.

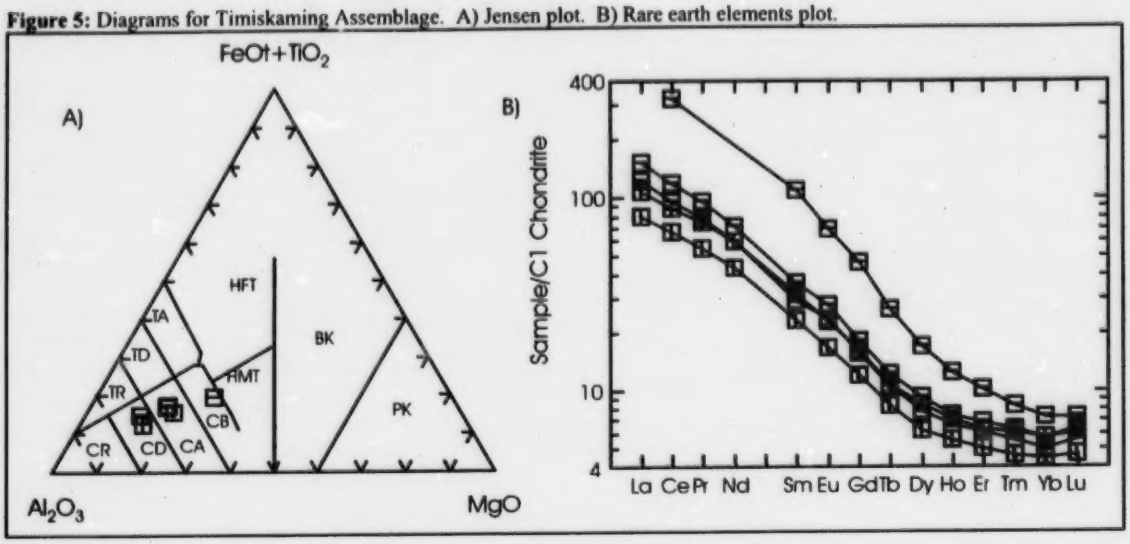

Figure 6: Diagrams for granitic batholith in Burrows Township. A) Discrimination diagram. B) Rare earth elements plot.

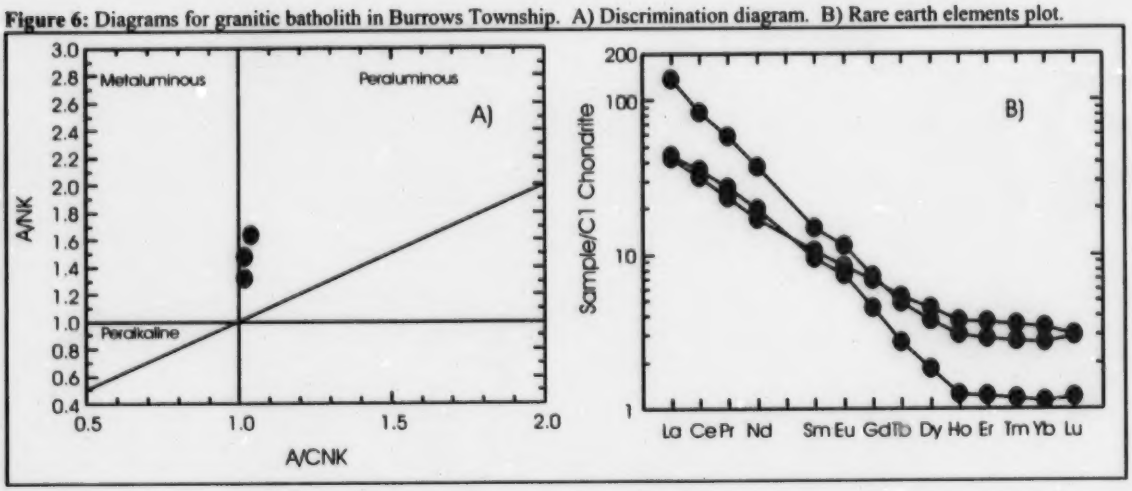

Figure 7: Sketch of a 50 m outcrop (01-HL-1237), showing compositional changes in Nipissing gabbro. Numbers indicate sub-units (see text).

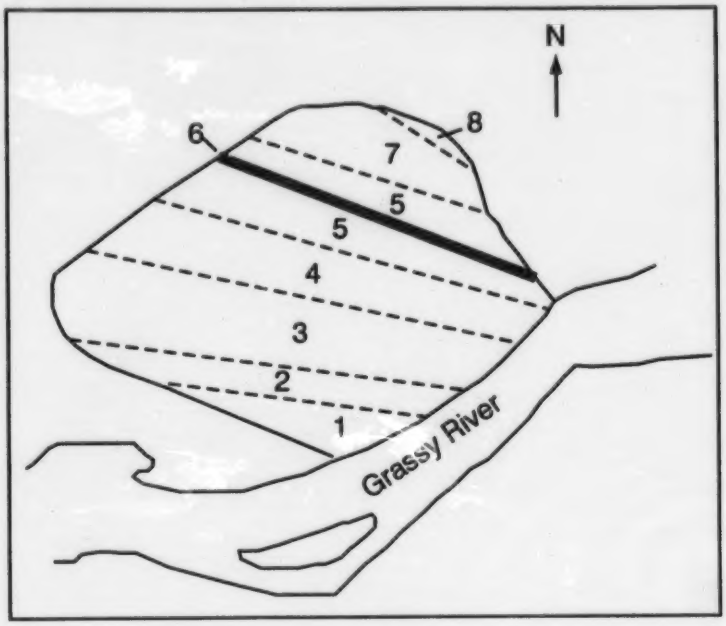

Photo 1: Elongated pillow used as top indicator in mafic to intermediate metavolcanic rocks.

Photo 2: Varioles (below scale card) in mafic to intermediate metavolcanic rocks near Sinclair Lake.

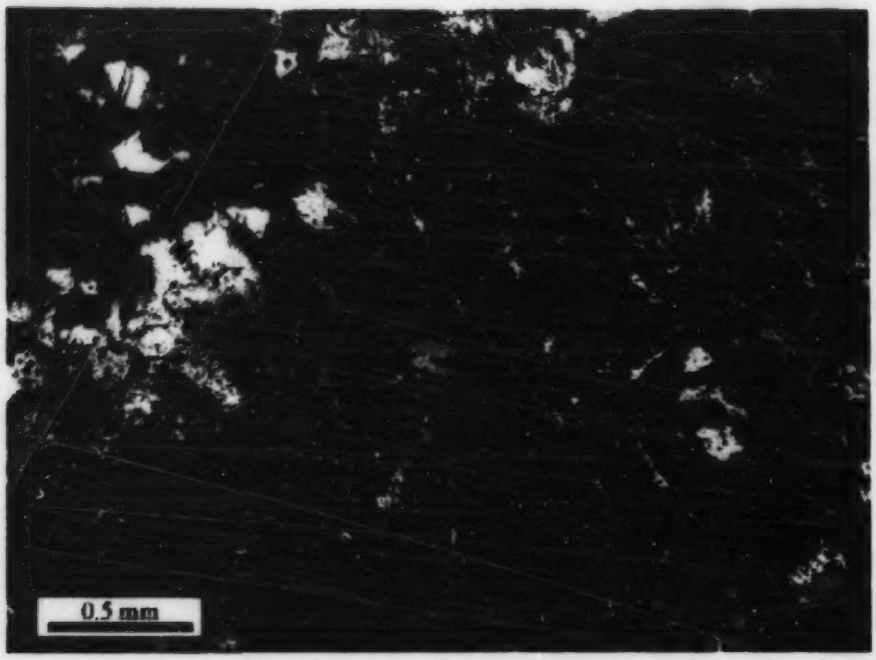

Photo 3: Radiating pyroxenes and olivine crystals in a devitrified matrix (cross polar photo).

Photo 4: Photomicrograph, under plane polarised light, of hyaloclastite shards in a devitrified matrix. Sample taken from the pillow rim of mafic metavolcanic rocks.

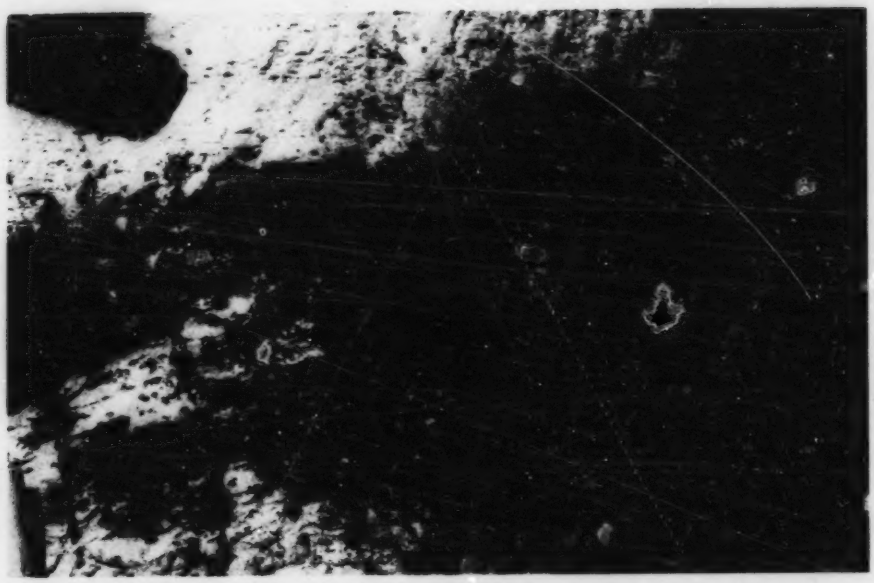

Photo 5: Intermediate to felsic lapilli tuff of volcaniclastic origin in Jumping Moose Creek.

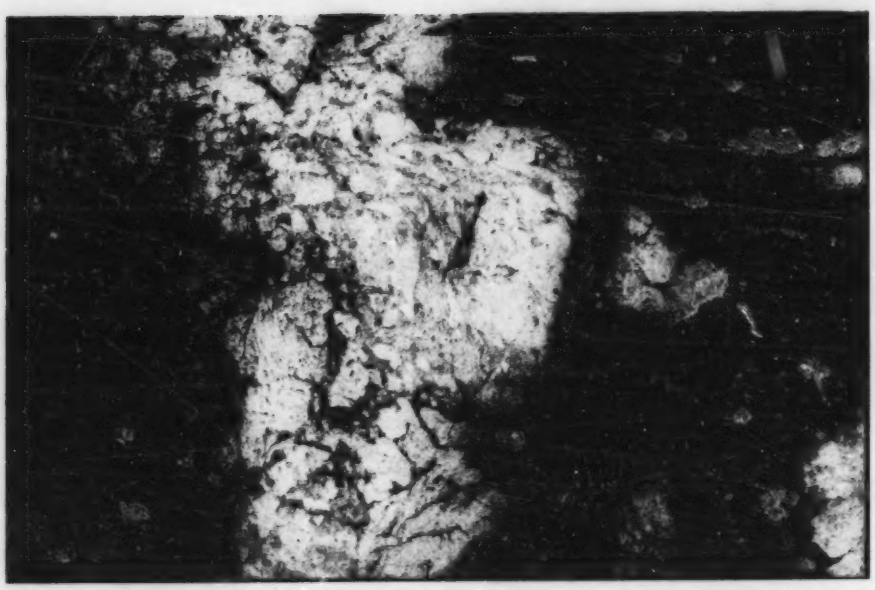

Photo 6: Felsic to intermediate autoclastic breccia near Grassy Road.

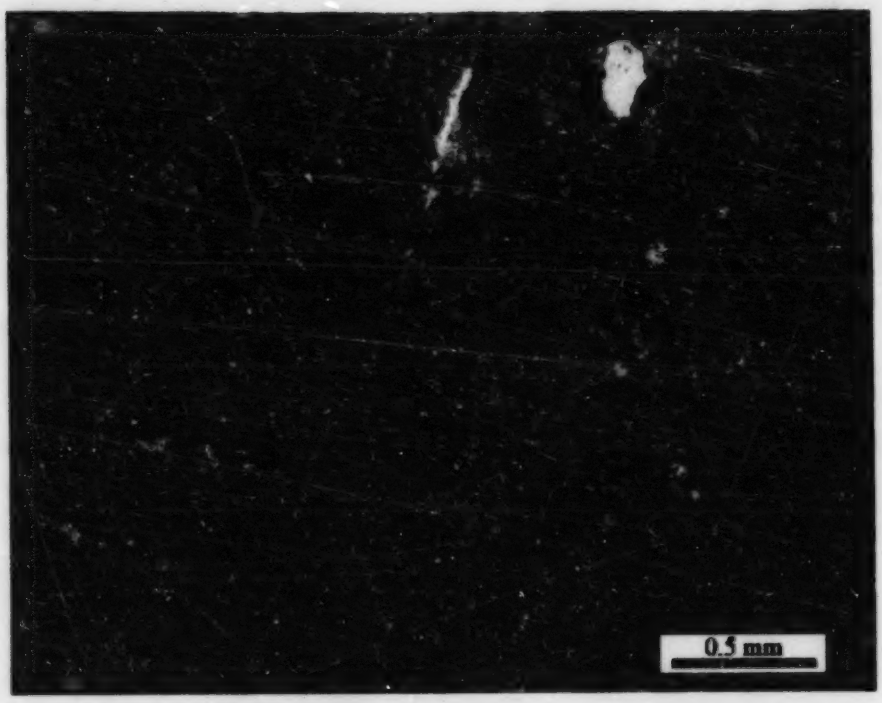

Photo 7: Microphotograph, plane polarised light, of felsic to intermediate autoclastic breccia. Sericitized angular fragments in a chloritized matrix.

Photo 8: Microphotograph, under plane polarised light, of carbonate filled amygdules in felsic to intermediate metavolcanic rock.

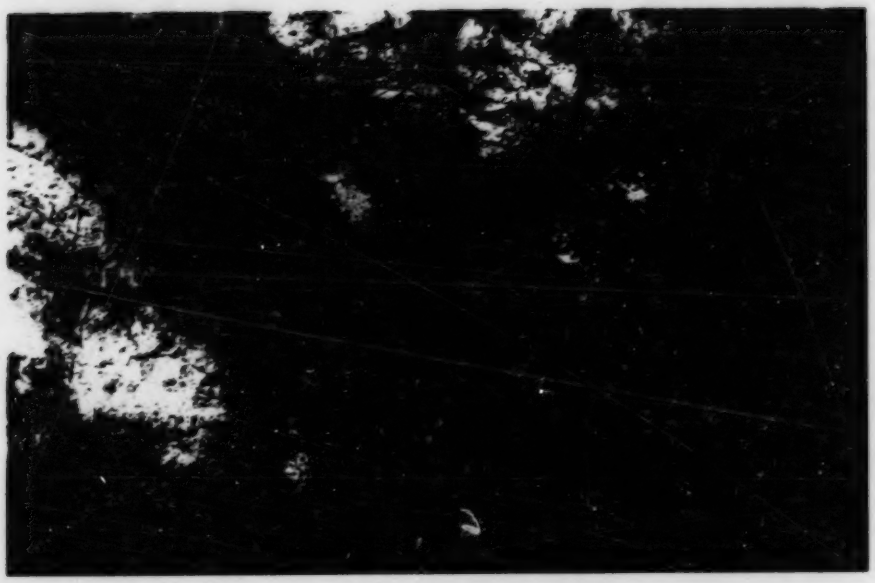

Photo 9: Felsic to intermediate pillows or lobes north of the Grassy River.

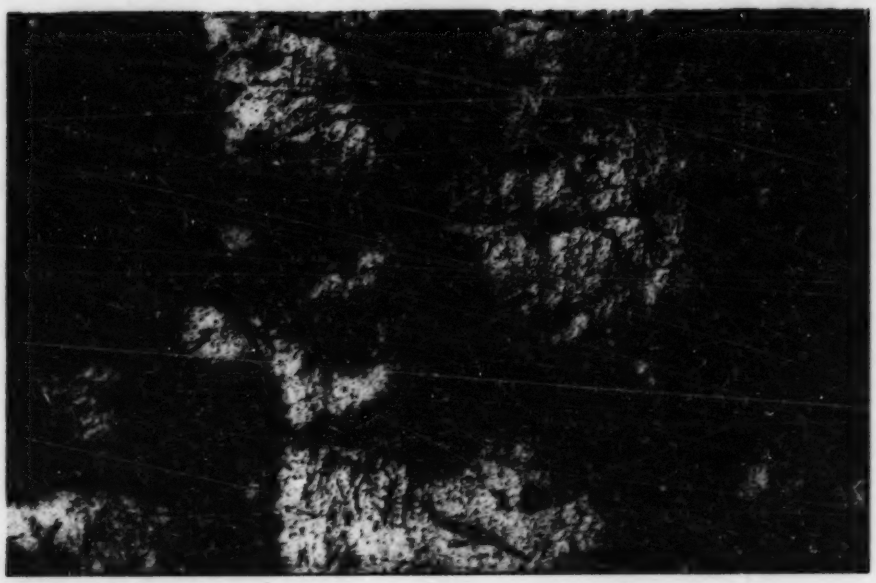

Photo 10: Rounded chert fragment in conglomerate of the Timiskaming assemblage.

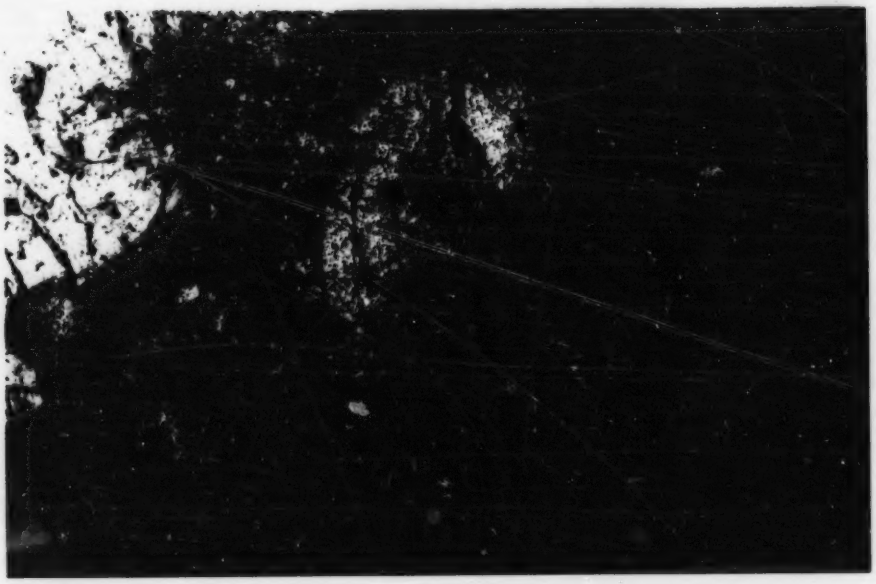

Photo 11: Rounded, cobble size, pumice fragment, in conglomerate of the Timiskaming assemblage.

Photo 12: Bedding in sandstone of the Timiskaming assemblage.

Photo 13: Cross-bedding in sandstone of the Timiskaming assemblage.

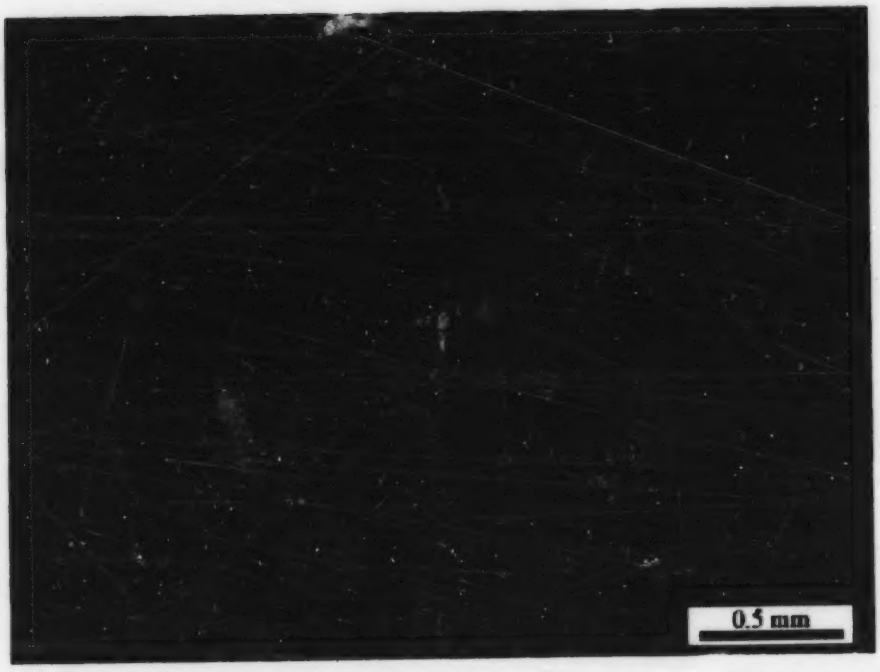

Photo 14: Microphotograph, plane polarised light, of euhedral crystals of amphibole in a volcaniclastic wacke of the Timiskaming assemblage.

Photo 15: Microphotograph, plane polarised light, of euhedral crystals of plagioclase and jasper clast in a volcaniclastic wacke of the Timiskaming assemblage.

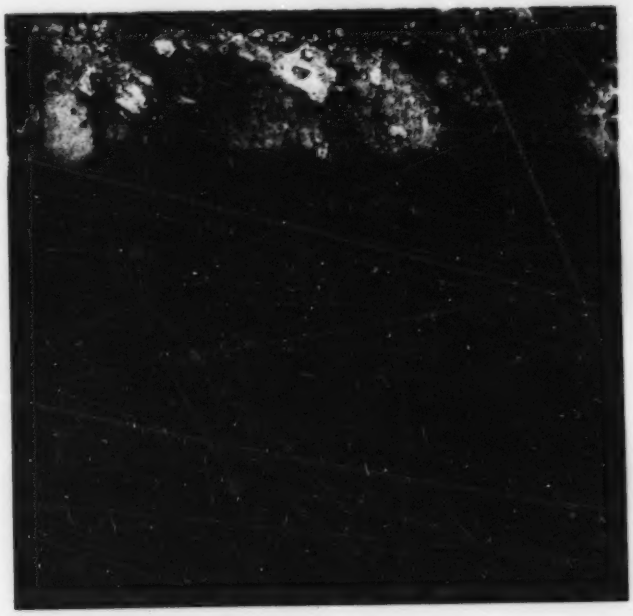

Photo 16: Well bedded sandstone of the Gowganda Formation near Ferris Lake.

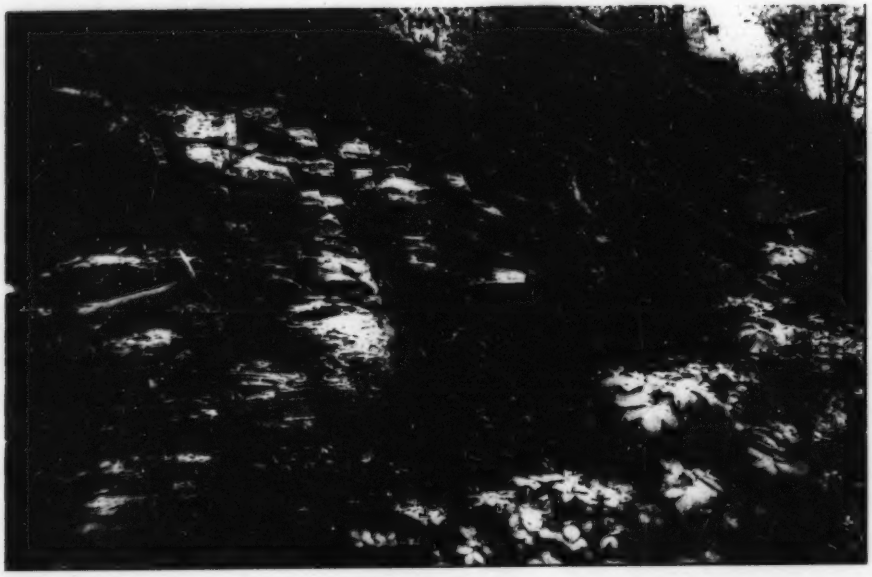

Photo 17: Well bedded siltstone of the Gowganda Formation on the Sansawaju Mountain.

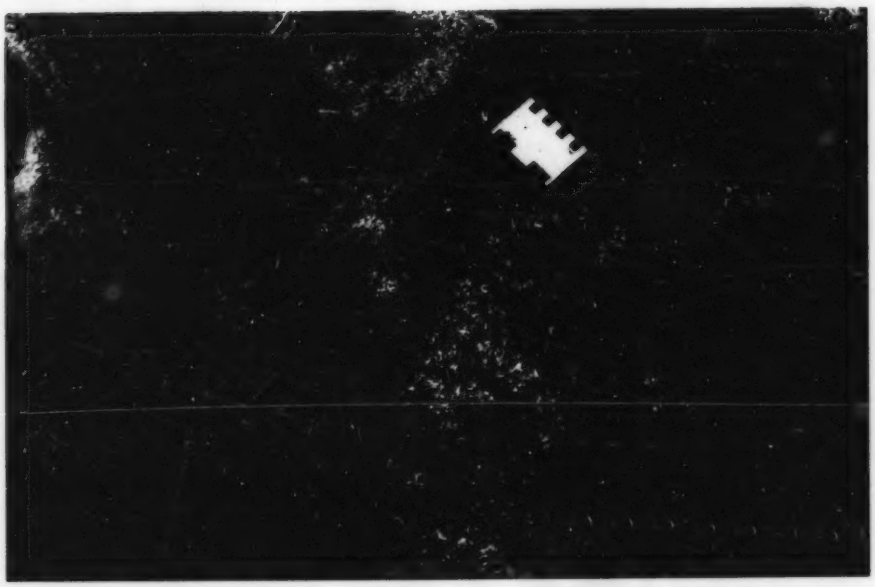

Photo 18: Sharp contact between sub-units 2 and 3 of the Nipissing Gabbro as seen on outcrop 01-HL-1237.

Table 1. Summary of southern Abitibi greenstone belt supracrustal assemblage names, ages, basal contacts, rock types and chemical affinities (Ayer and Trowell 2001).

Assemblage Name (Age in Ma)	Includes all or parts of Jackson and Fyon's (1991) assemblages	Basal contact relationships	Dominant rock types	Volcanic chemical affinity
Timiskaming (2687-2675)	Garrison, Hearst, Midlothian, Natal, Ridout, Timiskaming, Three Nations	Unconformable	Conglomerate, sandstone, mafic to intermediate volcanic	Alkalic to calc-alkalic
Porcupine (2696-2690)	Hoyle, Porcupine, Scapa, Whitney	Unconformable	Turbidite, minor conglomerate and iron formation	None observed
Blake River (2701-2697)	Blake River, Halcrow-Swayze, Krist, Skead, Watabeag	Conformable to disconformable	Mafic to felsic volcanic	Tholeiitic and calc-alkalic
Kinojevis (2702-2701)	Geike, Kinojevis (North and South), Watabeag	Conformable	Mafic and minor felsic volcanic	Tholeiitic
Tisdale (2710-2703)	Boston, Bowman, Cabot-Kevin, Duff-Rand, Eldorado, Kamiskotia, Garnet-Tooms, Geike, Halcrow-Swayze, Halliday, Horwood, Larder Lake, McElroy, Shining Tree, Tisdale, Watabeag	Conformable to disconformable	Ultramafic, mafic, intermediate to felsic volcanic and iron formation	Komatiitic, tholeiitic and calc-alkalic
Kidd-Munro (2719-2711)	Cabot-Kevin, Carscallen, Duff-Rand, Hong Kong, Kamiskotia, Kidd-Munro, Shining Tree	Conformable to disconformable	Ultramafic, mafic, intermediate and felsic volcanic and iron formation	Komatiitic, tholeiitic and calc-alkalic
Stoughton-Roquemaure (2723-2720)	Catherine-Pacaud, Kinojevis North, Stoughton-Roquemaure	Conformable to disconformable	Ultramafic, mafic, intermediate and felsic volcanic	Komatiitic, tholeiitic and calc-alkalic
Deloro (2730-2724)	Adair, Bartlett, Cabot-Kelvin, Carscallen, Deloro, Eldorado, Hanrahan, Hong Kong, Marion, Stoughton-Roquemaure, Shining Tree	Disconformable	Mafic, intermediate and felsic volcanic and iron formation	Tholeiitic and calc-alkalic
Pacaud (2750-2735)	Catherine-Pacaud, Hong Kong, Peterlong, Marion, Shining Tree, Sinclair	Unknown – removed by batholiths	Ultramafic, mafic and felsic volcanic	Komatiitic, tholeiitic and calc-alkalic

Table 3: Chemical analysis for the ultramafic metavolcanic (1), the mafic intrusive (6) and the granitic rocks (15). UTM coordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-GM-238B	01-GM-008A	01-GM-055A	01-GM-243B	01-HL-1038A	01-GM-062A	01-GM-067A	01-HL-1003A
Map Code	1	6	6	6	6	15	15	15
Easting	473820	467039	469214	466607	479400	472248	472507	465460
Northing	5292760	5289871	5293314	5291271	5299146	5297820	5299118	5293419
SiO_2 (wt%)	45.9	45.8	51.7		49.9	70.2	72.5	74
Al_2O_3	5.72	14.8	14.8		14.2	15	15.1	13.5
CaO	3.24	7.22	5.51		10.3	2.51	1.81	2.6
MgO	24.8	14.9	6.27		6.65	0.8	0.35	0.73
Na_2O	<0.01	2.09	3.13		1.95	4.87	5.38	4.2
K2O	0.03	0.26	0.57		0.55	2.01	2.46	1.19
Fe_2O_3	11.7	9.82	14.1		12.2	2.51	1.08	2.85
MnO	0.14	0.17	0.2		0.2	0.04	<0.01	0.03
TiO_2	0.325	0.285	0.86		0.911	0.265	0.145	0.305
P_2O_5	0.02	0.01	0.06		0.06	0.06	0.03	0.06
Cr_2O_3	0.21	0.05	<0.01		0.03	<0.01	<0.01	<0.01
LOI	6.75	4.5	3.1		2.3	1.85	0.55	0.7
Total	98.9	100	100.3		99.2	100.1	99.4	100.2
Ce (ppm)	3.4	1.72	5.38	32.19	8.38	19.57	21.65	51.22
Cs	0.51	0.82	0.22	0.39	1.03	0.99	0.56	0.74
Dy	0.94	1.22	3.82	13.06	3.51	1.14	0.46	0.95
Er	0.61	0.85	2.77	8.31	2.24	0.6	0.2	0.47
Eu	0.12	0.22	0.65	2.71	0.78	0.49	0.43	0.66
Gd	0.84	0.92	2.92	11.4	2.92	1.39	0.93	1.47
Hf	0.55	0.42	1.42	6.07	1.49	2.87	2.63	3.44
Ho	0.2	0.28	0.87	2.82	0.78	0.21	0.07	0.17
La	1.32	0.66	1.87	10.68	2.98	9.95	10.45	32.17
Lu	0.101	0.14	0.414	1.289	0.347	0.077	0.03	0.075
Nb	0.88	0.46	1.57	10.9	2.22	5.16	2.44	4.28
Nd	2.29	1.49	4.84	27.3	6.66	7.95	9.16	17.12
Pr	0.5	0.3	0.87	5.4	1.33	2.24	2.59	5.55
Rb	1.12	7.04	8.36	13.26	21.05	65.61	44.64	34.17
Sm	0.59	0.52	1.77	8.66	2.14	1.6	1.43	2.25
Sr	5.3	154.71	82.98	244.06	311.24	209.74	>450.00	215.72
Ta	N.D.	N.D.	N.D.	0.6	N.D.	0.5	N.D.	0.32
Tb	0.14	0.17	0.56	2.01	0.54	0.2	0.1	0.18
Th	0.11	N.D.	0.12	1.35	0.26	1.96	1.82	3.44
Tm	0.09	0.13	0.42	1.24	0.35	0.09	0.03	0.07
U	0.03	0.01	0.04	0.32	0.08	0.73	0.77	0.44
Y	4.96	7.38	22.86	70.84	19.27	6.3	2.33	4.91
Yb	0.6	0.86	2.66	8.06	2.2	0.57	0.19	0.46
Zr	18.37	13.79	46.91	213.95	51.15	106.27	82.76	132.49

Table 4a: Chemical analysis for the mafic to intermediate metavolcanic rocks (2) of Keewatin-age. UTM coordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-GM-042A	01-GM-072A	01-GM-077A	01-GM-208A	01-GM-224A	01-GM-238A	01-GM-238D	01-HL-1013A	01-HL-1020A	01-HL-1020B
Map Code	2	2	2	2	2	2	2	2	2	2
Easting	476902	476886	471868	491277	492384	473820	473820	468763	474115	474115
Northing	5293644	5292567	5288293	5292361	5293283	5292760	5292760	5291630	5292574	5292574
SiO_2 (wt%)	46.4	62.5	44.1	51.5	45.1	51.9	47.6	45.9	49.4	52.7
Al_2O_3	15.8	13.9	13.6	13.1	15.6	13.4	12.8	9.6	16.3	15.9
CaO	11.1	5.71	13.1	8.88	9.82	6.36	9	10.7	5.89	4.51
MgO	3.73	3.84	4.46	2.77	4.43	4.56	6.64	11.2	4.41	3.81
Na_2O	3.47	3.97	0.93	0.06	2.65	3.92	2.77	0.19	3.96	5.31
K2O	0.31	0.48	0.04	2.14	0.48	0.37	0.82	0.07	0.49	0.29
Fe_2O_3	11.6	6.77	13.2	11.1	13.8	13.9	9.96	10	13.8	12.2
MnO	0.31	0.11	0.23	0.24	0.26	0.28	0.17	0.21	0.31	0.24
TiO_2	0.871	0.914	0.9	1.148	1.284	1.837	0.74	0.609	1.453	1.321
P_2O_5	0.06	0.19	0.07	0.09	0.12	0.16	0.05	0.18	0.12	0.11
Cr_2O_3	0.04	0.02	0.01	0.02	0.02	<0.01	0.12	0.13	0.02	0.02
LOI	6.65	2.1	9.5	9.1	6.4	2.15	9.35	11.3	3	3.55
Total	100.4	100.6	100.2	100.1	100	98.8	100.1	100.2	99.1	99.9
Ce (ppm)	7.58	33.15	8.32	9.02	14.31	17.34	6.98	30.4	14.57	12.72
Cs	0.72	1.09	0.04	2.24	2.13	0.13	0.2	0.15	0.15	0.14
Dy	3.46	3.97	3.26	4.14	5.11	5.95	2.69	2.78	5.44	4.72
Er	2.33	2.31	2.24	2.68	3.52	3.94	1.7	1.59	3.4	2.92
Eu	0.82	1.21	0.77	1.22	1.01	1.3	0.7	1.07	1.23	0.89
Gd	2.88	4.25	2.69	3.5	4.33	5.19	2.35	3.49	4.64	4.1
Hf	1.29	3.64	1.39	2	2.31	2.82	1.21	1.69	2.52	2.25
Ho	0.74	0.83	0.73	0.9	1.15	1.29	0.58	0.55	1.2	1.02
La	2.8	14.47	3.13	2.91	5.48	6.35	2.62	13.7	5.41	4.53
Lu	0.337	0.338	0.34	0.443	0.537	0.601	0.253	0.221	0.531	0.466
Nb	2.18	7.43	2.19	3.35	3.79	4.92	2.06	2.67	3.98	3.67
Nd	6.24	17.67	6.53	8.54	10.83	13	5.56	17.16	11.24	9.44
Pr	1.19	4.37	1.32	1.61	2.25	2.67	1.1	4.14	2.26	1.98
Rb	10.59	12.83	0.43	91.52	17.72	7.89	15.67	1.44	11.06	7.01
Sm	2.05	3.93	2.05	2.7	3.25	3.91	1.8	3.79	3.51	3.03
Sr	108.54	312.24	139.54	17.99	104.46	107.42	94.89	74.32	139.22	53.41
Ta	N.D.	0.42	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Tb	0.52	0.65	0.49	0.63	0.79	0.9	0.41	0.5	0.83	0.73
Th	0.2	1.37	0.26	0.35	0.4	0.59	0.24	1.77	0.5	0.44
Tm	0.33	0.35	0.35	0.41	0.52	0.59	0.25	0.22	0.52	0.46
U	0.06	0.35	0.07	0.1	0.11	0.16	0.07	0.44	0.12	0.11
Y	19.89	21.18	18.76	25.08	30.49	33.3	14.76	14.71	29.17	25.88
Yb	2.09	2.14	2.14	2.69	3.38	3.72	1.62	1.46	3.37	2.87
Zr	46.54	142.95	49.06	71.79	81.49	99.65	42.79	64.58	87.37	79.92

Table 4b: Chemical analysis for the mafic to intermediate metavolcanic rocks (2) of Keewatin-age. UTM coordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-HL-1044B	01-HL-1051B	01-HL-1075A	01-HL-1085A	01-HL-1086A	01-HL-1099A	01-HL-1188A	01-HL-1215A
Map Code	2	2	2	2	2	2	2	2
Easting	477486	474064	492543	494070	494254	491213	481777	492904
Northing	5293212	5298442	5294498	5293626	5293604	5297537	5288775	5298409
SiO_2 (wt%)		54.9	50.3	48.8	50.5	49.7	58.7	50.9
Al_2O_3		15.5	14.8	14.2	14.4	17.4	16.8	14.2
CaO		6.27	10.6	10.9	9.92	7.26	2.03	13.6
MgO		5.5	7.3	7.88	7.08	5.18	3.7	5.95
Na_2O		4.84	2.16	1.97	2.38	3.12	5.19	1.31
K2O		0.53	0.13	0.13	0.1	0.54	0.21	0.07
Fe_2O_3		9.46	12	12.9	11.9	11	7.32	9.76
MnO		0.14	0.21	0.23	0.22	0.17	0.09	0.21
TiO_2		0.815	0.778	0.725	0.812	1.208	1.175	0.76
P_2O_5		0.05	0.06	0.05	0.06	0.25	0.25	0.05
Cr_2O_3		0.13	0.03	0.03	0.03	0.02	0.02	0.11
LOI		2.25	1.8	2.35	2.6	4.2	4.05	2.65
Total		100.4	100.2	100.3	100.1	100	99.6	99.6
Ce (ppm)	15.3	8.42	6.95	6.71	7.53	36.38	15.49	7.8
Cs	1.96	0.08	0.83	0.79	1.35	0.56	0.56	0.36
Dy	5.4	3.01	2.96	2.66	3	4.07	3.96	2.74
Er	3.55	1.87	1.97	1.65	2.02	2.31	2.35	1.7
Eu	1.06	0.66	0.64	1.72	0.68	1.45	1.04	0.66
Gd	4.59	2.66	2.48	2.33	2.55	4.35	3.77	2.23
Hf	2.57	1.35	1.22	1.07	1.22	3.47	3.91	1.18
Ho	1.19	0.64	0.65	0.58	0.68	0.83	0.82	0.59
La	5.69	2.94	2.47	2.63	2.81	15.64	5.44	2.85
Lu	0.55	0.293	0.307	0.243	0.304	0.331	0.352	0.255
Nb	4.23	2.3	1.95	1.71	1.97	8.22	8.42	2.24
Nd	11.17	6.63	5.63	5.2	5.86	19.9	10.37	5.71
Pr	2.38	1.34	1.13	1.02	1.16	4.87	2.28	1.19
Rb	6.02	6.61	4.17	4.14	2.87	16.11	7.21	1.26
Sm	3.5	2.18	1.78	1.74	1.93	4.24	3.1	1.76
Sr	99.91	71.11	118.24	217.52	110.47	278.74	138.23	55.13
Ta	N.D.	N.D.	N.D.	N.D.	N.D.	0.44	0.52	N.D.
Tb	0.82	0.49	0.45	0.41	0.45	0.68	0.63	0.41
Th	0.52	0.33	0.26	0.23	0.26	1.04	1	0.26
Tm	0.54	0.28	0.32	0.25	0.31	0.34	0.34	0.26
U	0.14	0.09	0.06	0.06	0.06	0.27	0.47	0.08
Y	30.07	15.91	17.2	15.45	17.89	21.58	22.63	15.63
Yb	3.36	1.86	1.94	1.67	1.93	2.18	2.15	1.71
Zr	84.	47.5	43.8	39.47	44.95	148.41	163.07	44.5

Table 5a: Chemical analysis for the felsic to intermediate metavolcanic rocks (3) of Keewatin-age. UTM coordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-GM-013A	01-GM-035A	01-GM-049A	01-GM-071A	01-GM-075A	01-GM-090A	01-GM-157A	01-GM-162A	01-GM-237A	01-GM-244A	01-HL-1024A	01-HL-1030A
Map Code	3	3	3	3	3	3	3	3	3	3	3	3
Easting	466583	481714	468532	477716	481821	482001	481718	481129	474831	467039	481515	479321
Northing	5291347	5292331	5293580	5291472	5297836	5298331	5290603	5289870	5290138	5291060	5291131	5291133
SiO_2 (wt%)	69	56.1	67.4	65.1	57.7	62.1	64.3	65.4	47.7	61.6		52.4
Al_2O_3	14.9	19.2	15.3	14.5	14.7	16.8	14.9	15.6	15.2	13.1		15.4
CaO	1.94	3.25	1.23	2.64	7.8	3.19	3.52	3.14	9.29	4.83		5.8
MgO	1.61	2.25	2.97	2.2	2.61	2.94	1.88	1.56	2.44	2.05		5.55
Na_2O	5.47	7.27	5.84	2.95	4.2	4.88	5.96	4.02	4.44	3.67		2.62
K2O	0.94	1.65	0.41	2.32	0.67	0.84	0.24	1.35	0.28	0.31		0.42
Fe_2O_3	3.18	5.7	3.79	7.25	6.17	6.18	4.52	5.65	9.84	8.98		10.6
MnO	0.02	0.08	0.05	0.11	0.13	0.09	0.07	0.09	0.4	0.4		0.14
TiO_2	0.277	0.662	0.369	0.543	0.855	0.546	1.233	0.867	1.351	0.283		2.219
P_2O_5	0.05	0.52	0.09	0.13	0.18	0.12	0.36	0.25	0.24	0.06		0.52
Cr_2O_3	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	0.02	<0.01		0.01
LOI	1.65	2.8	1.95	2.65	4.95	2.45	2.75	2.25	9.05	4.95		4.25
Total	99	99.5	99.3	100.5	100	100.2	99.7	100.2	100.3	100.3		99.9
Ce (ppm)	19.22	63.35	23.11	42.28	38.06	35.26	40.28	48.07	26.42	22.01	49	58.15
Cs	1.9	1.45	0.38	1.64	0.98	1.91	0.53	0.88	0.23	0.38	1.06	0.85
Dy	0.93	2	1.25	3.68	2.94	2.69	4.46	3.59	3.82	1.02	4.13	5.18
Er	0.46	0.87	0.69	2.27	1.64	1.64	2.46	1.93	2.36	0.56	2.28	2.68
Eu	0.54	1.57	0.65	1.16	0.96	0.98	1.16	1.3	1.14	0.5	1.48	2.46
Gd	1.22	4.15	1.54	4.01	3.43	2.98	4.48	4.22	3.82	1.4	4.73	6.54
Hf	3	2.65	3.84	4.3	3.13	3.79	5.01	4.73	3.23	2.76	4.28	5.16
Ho	0.18	0.34	0.24	0.78	0.58	0.55	0.9	0.71	0.8	0.21	0.82	1.02
La	9.67	27.83	10.79	20.64	17.5	17.21	16.02	22.21	10.16	11.62	22.97	22.87
Lu	0.076	0.107	0.114	0.332	0.226	0.234	0.341	0.275	0.358	0.085	0.327	0.34
Nb	2.77	4.4	4.84	7.46	8.92	6.57	14.63	10.26	8.09	3.18	11.47	20.43
Nd	8.4	33.97	9.88	18.74	18.73	15.69	21.85	22.86	15.84	9.02	24.5	34.9
Pr	2.26	8.5	2.76	5.09	4.9	4.22	5.48	6.06	3.75	2.55	6.29	8.45
Rb	24.77	37.2	8.39	56.26	24.71	29.9	6.28	39.26	6.83	5.8	13.29	8.9
Sm	1.55	6.3	1.87	4.18	3.76	3.13	4.81	4.69	3.71	1.66	5.01	7.3
Sr	230.66	>450.00	90.14	159.45	269.49	225.27	426.2	216.26	145.57	142.47	349.68	427.61
Ta	N.D.	N.D.	0.36	0.53	0.48	0.44	0.76	0.67	0.43	N.D.	0.61	1
Tb	0.17	0.45	0.22	0.63	0.51	0.46	0.72	0.63	0.62	0.19	0.72	0.97
Th	1.34	3.02	1.55	3.48	1.46	2.12	1.86	3.66	0.95	1.65	1.79	1.49
Tm	0.07	0.11	0.11	0.33	0.23	0.23	0.37	0.28	0.37	0.09	0.33	0.38
U	0.34	0.83	0.44	0.88	0.38	0.55	0.47	0.95	0.26	0.38	0.47	0.38
Y	4.71	8.96	6.89	20.98	15.62	14.59	23.34	18.56	19.87	6	22.19	26.81
Yb	0.49	0.72	0.69	2.06	1.53	1.44	2.25	1.83	2.29	0.53	2.17	2.28
Zr	113.29	105.28	152.3	173.4	131.81	150.95	208.28	183.41	127.5	100.06	173.34	216.63

Table 5b: Chemical analysis for the felsic to intermediate metavolcanic rocks (3) of Keewatin-age. UTM coordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-HL-1061A	01-HL-1166A	01-HL-1184A	01-HL-1184B	01-HL-1193A	01-HL-1229B	01-HL-1249A	01-HL-1249B
Map Code	3	3	3	3	3	3	3	3
Easting	477187	488002	482154	482154	481874	489765	479875	479875
Northing	5289958	5297195	5289676	5289676	5289579	5298722	5289249	5289249
SiO_2 (wt%)	72.2	60.3	58.3	61	62.8	59.3	58.3	60.7
Al_2O_3	13.3	16.1	13.1	14.9	16.1	19.3	15.6	14.9
CaO	3.07	6.23	7.3	2.73	5.02	3.82	5.76	2.25
MgO	0.84	3.88	2.94	3.67	2.23	2.11	3.67	4.9
Na_2O	2.9	3.64	2.44	4.92	3.16	5.98	3.41	3.49
K2O	1.79	0.18	1.11	0.17	1.27	0.46	1.25	1.76
Fe_2O_3	1.77	5.77	5.94	6.82	5.36	5.17	7.68	7.96
MnO	0.03	0.08	0.19	0.11	0.09	0.11	0.14	0.09
TiO_2	0.359	0.558	0.774	0.879	0.791	0.512	1.201	0.819
P_2O_5	0.09	0.11	0.22	0.25	0.2	0.09	0.22	0.19
Cr_2O_3	<0.01	0.01	0.01	0.02	<0.01	<0.01	0.02	<0.01
LOI	3.75	3.15	7.4	3.95	3.35	3.25	2.6	3.05
Total	100.1	100.1	99.7	99.4	100.4	100.2	99.8	100.1
Ce (ppm)	35.05	28.41	41.95	43.12	46.38	24.63	34.96	43.79
Cs	0.94	0.5	0.67	1.3	2.65	0.37	1.32	1.66
Dy	2.86	2.76	4.18	4.28	4.25	1.95	4.05	3.77
Er	1.59	1.58	2.3	2.52	2.36	1.02	2.25	2.13
Eu	0.78	0.87	1.46	1.57	1.48	0.65	1.19	1.16
Gd	3.1	3.02	4.53	4.7	4.7	2.2	4.2	4
Hf	3.78	3.05	3.66	4.29	4.34	3.14	3.4	4.23
Ho	0.56	0.57	0.85	0.88	0.83	0.38	0.8	0.76
La	17.44	13.31	18.62	18.37	21.6	11.97	14.54	20.99
Lu	0.205	0.238	0.328	0.361	0.335	0.158	0.326	0.312
Nb	6.56	5.66	8.64	10.19	9.34	5.62	8.96	8.1
Nd	15.54	13.86	21.59	22.88	23.05	11.19	19.28	20.62
Pr	4.13	3.55	5.52	5.64	5.83	2.9	4.7	5.38
Rb	43.19	6.01	28.67	4.25	38.46	12.37	39.12	56.47
Sm	3.32	3.09	4.63	4.86	4.93	2.29	4.28	4.31
Sr	103.51	154.12	130.17	311.33	256.22	249.76	212.12	211.01
Ta	0.57	0.4	0.52	0.62	0.62	0.46	0.48	0.52
Tb	0.47	0.47	0.69	0.74	0.7	0.35	0.67	0.61
Th	4.28	1.72	1.62	1.76	2.62	2.07	1.35	2.51
Tm	0.23	0.24	0.35	0.36	0.34	0.16	0.34	0.32
U	0.86	0.45	0.43	0.47	0.7	0.54	0.35	0.62
Y	15.19	14.99	22.51	23.34	23.14	9.99	22.59	21.13
Yb	1.38	1.48	2.12	2.29	2.08	0.99	2.02	2.04
Zr	149.1	125.32	156.16	182.82	181.11	134.34	148.88	172.69

Table 6: Chemical analysis for the rocks of the Timiskaming assemblage. Clastic metasedimentary rocks (10) and reworked metavolcanic rocks (13). UTM co-ordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-GM-133A	01-GM-145A	01-GM-171A	01-GM-184A	01-GM-194A	01-GM-196A
Map Code	10	10	10	10	13	13
Easting	482952	485622	491088	493680	492289	492725
Northing	5291471	5289831	5289587	5290662	5292150	5292087
SiO_2 (wt%)	45.7	61.8	60.4	62	65.1	60.1
Al_2O_3	14	15.8	16.6	16	16.1	16.1
CaO	14.4	4.64	3.58	3.31	1.69	3.59
MgO	5.56	3.38	3.62	2.22	2.5	3.84
Na_2O	2.99	4.75	5.01	5.02	5.78	5.63
K2O	0.2	0.34	1.81	3.18	1.23	0.87
Fe_2O_3	7.24	5.77	6.28	4.5	4.04	5.72
MnO	0.28	0.08	0.09	0.09	0.06	0.09
TiO_2	0.758	0.552	0.586	0.54	0.474	0.537
P_2O_5	0.05	0.13	0.17	0.48	0.12	0.14
Cr_2O_3	0.03	0.02	0.03	0.01	0.01	0.02
LOI	8.75	2.9	2	1.8	2.4	2.1
Total	100	100.2	100.1	99.2	99.5	98.7
Ce (ppm)	5.79	58.63	71.8	197.26	42.18	55.49
Cs	1.41	0.92	1.23	1.07	1.53	0.72
Dy	2.59	1.97	2.31	4.28	1.62	2.21
Er	1.66	1	1.12	1.67	0.85	1.08
Eu	0.67	1.35	1.6	3.94	1	1.35
Gd	2.16	3.2	3.71	9.41	2.55	3.4
Hf	1.12	2.45	3.11	4.21	2.67	2.69
Ho	0.57	0.37	0.42	0.7	0.32	0.41
La	2.15	28.87	35.53	>100.00	19.51	26.32
Lu	0.252	0.141	0.162	0.185	0.123	0.16
Nb	1.86	3.72	4.76	4.42	3.16	3.22
Nd	4.77	27.44	33.25	>100.00	20.64	28.34
Pr	0.94	7.36	9.02	>25.00	5.36	7.24
Rb	4.41	6.27	39.77	62.99	37.55	19.11
Sm	1.65	4.47	5.54	16.62	3.64	5.01
Sr	282.41	180.66	>450.00	>450.00	>450.00	>450.00
Ta	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Tb	0.4	0.39	0.45	0.98	0.32	0.41
Th	0.2	2.49	3.47	13.92	2.83	3.22
Tm	0.25	0.14	0.16	0.21	0.12	0.16
U	0.06	0.59	0.82	3.3	0.77	0.83
Y	14.91	9.35	10.98	18.59	8.61	11.07
Yb	1.7	0.85	0.97	1.24	0.78	0.99
Zr	40.23	100.36	125	180.2	102.47	104.83

Table 7: Chemical analysis for the Nipissing Gabbro (19). UTM co-ordinates of all sample locations are in Zone 17 using NAD 27. N.D. - not determined.

Sample	01-HL-1231B	01-HL-1231A	01-HL-1237A	01-HL-1237B	01-HL-1237C	01-HL-1237D	01-HL-1237E	01-HL-1238A
Map Code	19	19	19	19	19	19	19	19
Easting	485713	485713	488045	488045	488045	488045	488045	488052
Northing	5297269	5297269	5297292	5297292	5297292	5297292	5297292	5297424
SiO_2 (wt%)	47.9		42.1	44.1	69.7	46.4	35.8	46.5
Al_2O_3	17.1		11.2	12.1	11.4	15.4	14.4	19.2
CaO	12.1		10.5	12.5	5.62	7.9	14.8	11.8
MgO	5.79		4.22	2.3	0.7	4.95	3.31	5.1
Na_2O	2.61		1.09	1.16	0.57	2.71	1.15	3.2
K2O	0.24		0.06	0.71	2.34	0.1	0.87	0.1
Fe_2O_3	10.9		18	12.2	2.99	16.7	12.7	10.2
MnO	0.18		0.2	0.18	0.07	0.2	0.21	0.14
TiO_2	0.857		2.144	1.512	0.535	1.869	1.926	0.677
P_2O_5	0.06		0.11	0.13	0.11	0.08	0.05	0.06
Cr_2O_3	<0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
LOI	2.5		10.5	12.6	5.75	3.95	15	3.35
Total	100.3		100.1	99.4	99.8	100.3	100.2	100.3
Ce (ppm)	7.31	7.22	12.51	9.92	10.29	9.16	9.94	8.13
Cs	0.86	0.74	0.36	0.59	1.43	0.25	0.95	0.54
Dy	3.2	3.84	4.49	5.68	6.18	3.56	3.64	2.54
Er	2.06	2.42	3.02	3.72	4.96	2.31	2.32	1.62
Eu	0.8	0.62	1.09	1.06	1.37	0.91	0.87	0.7
Gd	2.67	2.73	3.71	4.39	4.52	2.96	2.97	2.21
Hf	1.28	2.15	2.17	2.58	8.86	1.66	1.41	1.12
Ho	0.7	0.82	1	1.24	1.52	0.78	0.79	0.56
La	2.5	2.52	4.4	3.31	3.63	3.29	3.5	3.18
Lu	0.319	0.37	0.476	0.578	1.032	0.373	0.337	0.24
Nb	2.11	3.2	4.3	4.87	8.88	2.77	2.66	1.94
Nd	5.98	5.94	9.82	8.78	8.66	7.29	7.41	5.64
Pr	1.17	1.17	2	1.69	1.67	1.5	1.55	1.17
Rb	6.32	3.97	0.97	20.89	65.89	1.54	24.84	1.74
Sm	2.02	2.01	2.81	2.9	2.86	2.3	2.33	1.64
Sr	179.8	63.47	67.26	49.12	22.98	195.58	55.38	201.93
Ta	N.D.	N.D.	N.D.	N.D.	0.64	N.D.	N.D.	N.D.
Tb	0.49	0.56	0.68	0.82	0.86	0.54	0.55	0.38
Th	0.25	0.47	0.44	0.52	1.68	0.33	0.3	0.23
Tm	0.32	0.38	0.46	0.57	0.87	0.37	0.35	0.24
U	0.06	0.24	0.11	0.11	0.41	0.09	0.06	0.06
Y	17.84	19.63	25.98	32.97	42.35	20.6	19.87	14.29
Yb	2.06	2.44	2.99	3.64	6.09	2.35	2.14	1.51
Zr	46	80.66	80.24	94.96	334.28	59.75	50.22	42.06

Metric Conversion Table

Conversion from SI to Imperial			Conversion from Imperial to SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
		LENGTH			
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
		AREA			
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
		VOLUME			
1 cm^3	0.061 023	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.307 951	cubic yards	1 cubic yard	0.764 554 86	m^3
		CAPACITY			
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
		MASS			
1 g	0.035 273 962	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 747	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 622 6	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311 3	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 90**	t
		CONCENTRATION			
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

	Multiplied by	
1 ounce (troy) per ton (short)	31.103 477	grams per ton (short)
1 gram per ton (short)	0.032 151	ounces (troy) per ton (short)
1 ounce (troy) per ton (short)	20.0	pennyweights per ton (short)
1 pennyweight per ton (short)	0.05	ounces (troy) per ton (short)

Note: Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries, published by the Mining Association of Canada in co-operation with the Coal Association of Canada.

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